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Marine Engineering

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NEW STEAMER ASBURY PARK, FOR THE NEW YORK-SANDY HOOK ROUTE.

For fifteen years all new yachts sailing in or around the harbor of New York, which claim any great amount of speed, have invariably attempted to establish their reputation in this line by racing with either the *Monmouth* or *Sandy Hook,* plying between New York and Atlantic Highlands, in the service of the Central Railroad of New Jersey.

Although these vessels came out so many years ago, it is but few yachts or Long Island sound steamers that can hold their own against them. The course from the New York pier to the one at Atlantic Highlands is 18 nautical miles, down through New York bay, the Narrows, and across the lower bay, the last 3 miles being through shoal water across the Flats; yet the distance is covered by these two boats in about the average of one hour five minutes. Speed and regularity are the two most essential requirements of this service. The vessels run on the schedule as exact as a railroad train.

To meet the increased travel over this line to and from the Jersey coast resorts, last year the owners contracted with the William Cramp and Sons Ship and Engine Building Company, the builders of the *Monmouth,* for a new steamer, about 300 feet long, to draw not more than 11 feet, and on trial of 4 hours to maintain an average speed of 20 knots. The first keel plate was laid September 13, 1902, and the first frame raised October 23, 1902. On March 28, 1903, a very successful launch was made and the vessel was christened the *Asbury Park.* After the launch the boilers and engines were at once installed and the work pushed vigorously toward completion, and on June 5, 1903, the vessel was finished and left the yard for New York for delivery to owners.

FAST TWIN-SCREW STEAMER ASBURY PARK, FOR THE NEW YORK-SANDY HOOK ROUTE.
[Photographed especially for Marine Engineering by E. Muller.]

The *Asbury Park,* like her running mates, is devoted entirely to passengers, no cargo being carried. The general arrangement is shown on pages 496 and 497, which gives deck plans and longitudinal section.

In the forward hold is the chain locker, a large peak tank after the collision bulkhead; then follow two large compartments for stores, the forward one

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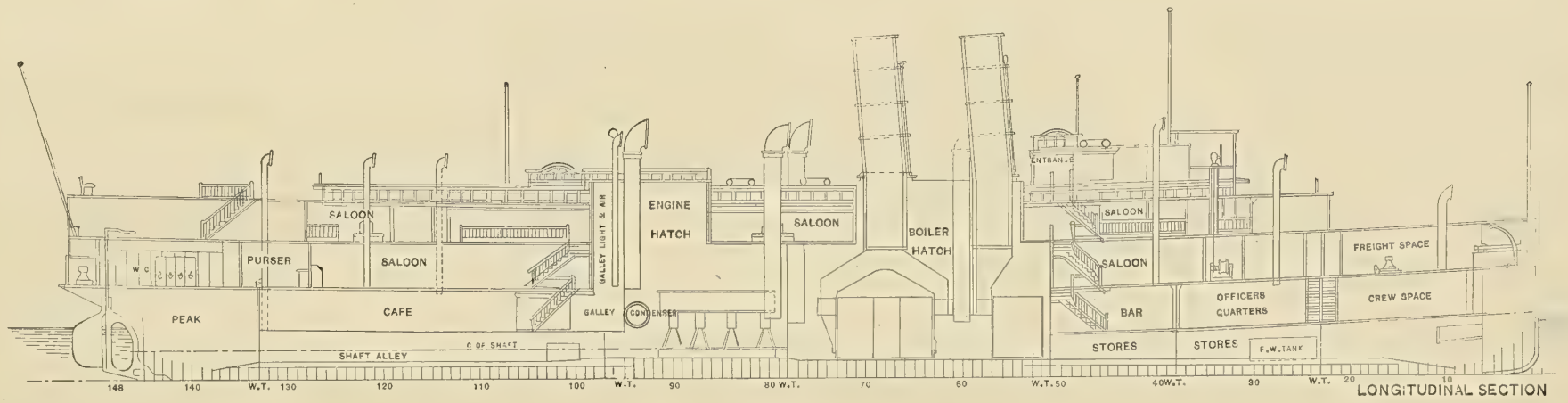
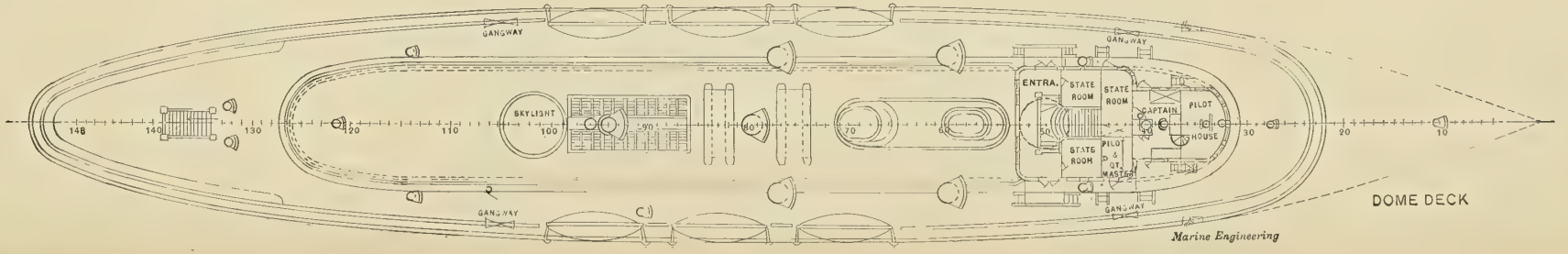
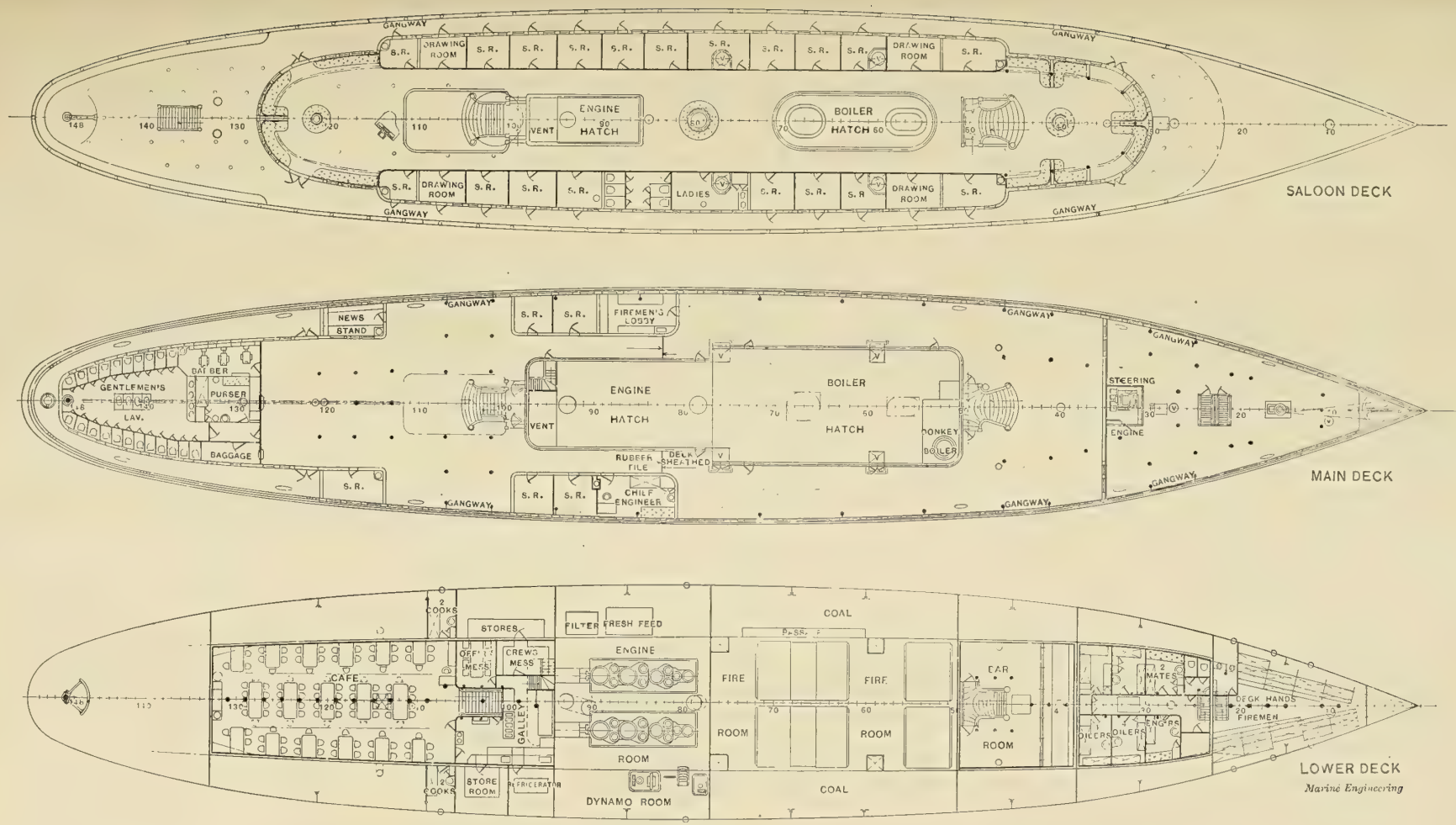
containing fresh-water tank. On lower deck forward, aft the collision bulkhead, is the forecastle with berths for 9 deck hands and 15 firemen. It is entered from companionway on the main deck, and is fitted with wash room and closets. In the next water-tight compartment are the engineers' and officers' quarters; on the port side are state rooms for 5 porters, 4 watchmen, and 2 mates, while on the starboard side are two rooms for the oilers and a room for the first and second assistant engineers. The next water-tight compartment is devoted entirely to the bar room, entered by winding stairs from the main deck.

The boilers and coal bunkers occupy the full breadth of the ship for a distance of 54 feet, the coal bunkers being arranged on either side of the ship. In the next compartment are the two sets of three-cylinder, quadruple-expansion engines and all auxiliary machinery. Following aft is the steward's department, which consists of a galley, placed amidships, crew's mess room and officers' mess room and stores on the port side, and pantry, refrigerators, and store room on the starboard side. Two state rooms for the cooks are directly aft of store rooms on either side. The café, or dining saloon for passengers, occupies the space aft of the collision bulkhead, entered by stairs from the main deck. On the center line in the shaft alley is placed a fresh-water tank.

The anchor and windlass are placed on the main deck, a davit being fitted forward to swing anchor overboard through large side ports. The steam-steering engine is placed just forward of a screen bulkhead. The staircase just forward of the boiler casing leads from the deck to the main saloon above. Abreast of the engine room are the chief engineer's room and two state rooms on the starboard side and a firemen's lobby and two state rooms on the port side. A large ventilator is arranged just aft of the engine hatch for carrying light and air to the galley, and on the port side is a stairway leading from the deck down to the galley and mess rooms. The quarter deck is spacious, laid with rubber interlocking tiles. One state room and a news stand are aft of the gangways. At the after end are the







LONGITUDINAL AND DECK PLANS OF THE NEW STEAMER ASBURY PARK, OWNED BY THE CENTRAL RAILROAD OF NEW JERSEY.

purser's office, barber shop, and a passage leading to the toilet rooms. The main stairway leads to the saloon on the deck above. Doors open out to a narrow deck for convenience in handling the line, and at the after end is the steam capstan. The joinery for this deck is in quartered oak.

There is a large house on the saloon deck, about 195 feet long. The forward end has large plate-glass windows at the front and side and is fitted with comfortable divans. Continuing aft on either side are 19 large state rooms, 4 drawing rooms, and a ladies' boudoir. The joinery of this deck is in quartered oak, and abundant light

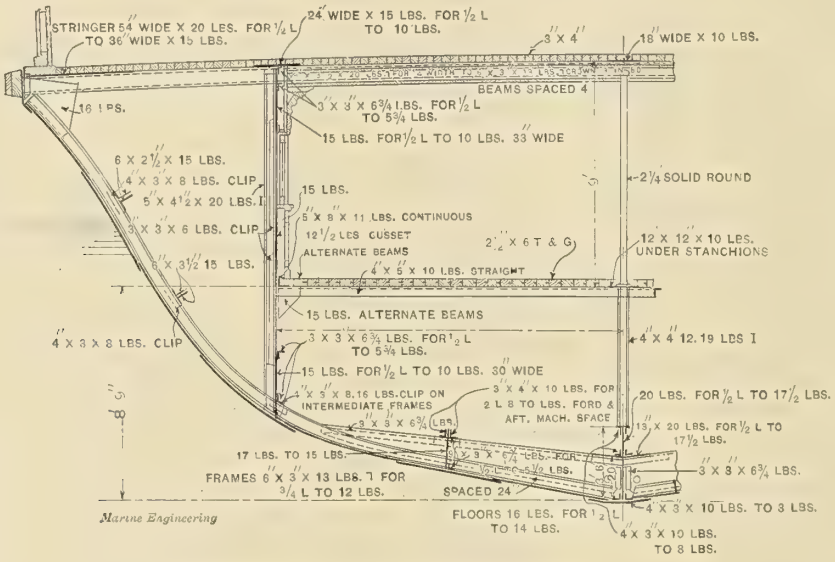
is admitted through side lights above the state rooms and through a large dome aft. The after end of cabin is fitted up similarly to the forward end. The deck is covered with Wilton carpets of olive tint, and the general color of furnishings is also in olive.

A large deck space is provided both forward and aft, the line of dome deck forward extending from well forward of the house to the stern. Gangways are placed on both sides at the forward and after quarters. The dome deck gives large open passenger space, while at the forward end are the pilot house, captain's room, pilot and quartermaster's room, and three state rooms. This deck is reached from the saloon by forward staircase landing in the entrance hall, and at the after end by a companionway which leads from the open saloon deck. Six lifeboats swing on davits and three liferafts are provided. A large skylight is fitted over the engine hatch and galley ventilator, and another is placed over the main stairway, as mentioned above. Four large ventilators carry air to the boiler room, two to the engine room, one to the galley, and several others are fitted to supply fresh air.

HULL.

The construction of this boat embraces several interesting features. In the first place, to build a boat of this size, and give her enough engine power to drive her at 20 knots speed at a draft of not over 11 feet, requires that weights be cut down and the hull lightened wherever possible without interfering with strength. From the sections of the *Asbury Park* given herewith the scantlings of members will be found. It will be noticed that the molded depth is about 17 feet; to provide for longitudinal strength for this shallow hull, two fore-and-aft bulkheads are fitted in the way of boiler and engine rooms, and the strength carried to the ends by lattice girders, as shown in section. These two bulkheads and girders extend from the bottom to the main deck from end to end of the vessel. The form of the frames shown in the sections should be especially noticed: instead of rising with maximum beam at the water line, they flare out and are given a reverse curve which carries them out to the guard; thus the increased beam of passenger steamboats is secured without exposing the counter to the force of the sea, the vessel is made stiff against rolling due to the increased buoyancy, and this space is available for coal bunkers or for store rooms.

The hull is divided into seven compartments by six water-tight bulkheads. Frame No. 5 is the forward collision bulkhead; forward holds with chain locker extend as far as frame 23; at this point and also at frame 38 are water-tight bulkheads. No. 50 forms forward boiler-room bulkhead, No. 78 is forward engine-room bulkhead in which is placed a water-tight door, and frame No. 95 is after engine-room bulkhead, recessed at bottom for thrust bearings, fitted with water-tight door leading into the shaft alley; and at frame No. 133 are the stern-tube bulkheads, or really deep frames for the two shafts. Each of these two bulkheads extends from the side of the ship to a point about 4 feet from the center line to carry the stern tubes. The after collision bulkhead is at frame No. 145. Web frames are fitted one in each forward compartment, two in the boiler room, one in engine room, and two in after hold, to provide for special stiffness.


STRINGER 54" WIDE X 20 LBS. FOR 1/4 L TO 36" WIDE X 15 LBS.
24" WIDE X 15 LBS. FOR 1/2 L TO 10 LBS.
3" X 4"
18" WIDE X 10 LBS.
BEAMS SPACED 4
3" X 3" X 6 3/4 LBS. FOR 1/2 L TO 5 3/4 LBS.
15 LBS. FOR 1/2 L TO 10 LBS. 33" WIDE
6 X 2 1/2" X 15 LBS.
4" X 3" X 8 LBS. CLIP
5" X 4 1/2" X 20 LBS. I
15 LBS.
5" X 8" X 11 LBS. CONTINUOUS
12 1/2 LBS GUSSET ALTERNATE BEAMS
2 1/2" X 6 T & G
2 1/4" SOLID ROUND
12 X 12" X 10 LBS. UNDER STANCHIONS
4" X 5" X 10 LBS. STRAIGHT
15 LBS. ALTERNATE BEAMS
4" X 3" X 8 LBS. CLIP
3 X 3 X 6 3/4 LBS. FOR 1/2 L TO 5 3/4 LBS.
4" X 4" 12.19 LBS I
15 LBS. FOR 1/2 L TO 10 LBS. 30" WIDE
3" X 3" X 8.16 LBS. CLIP ON INTERMEDIATE FRAMES
3" X 4" X 10 LBS. FOR 2 L 8 TO LBS. FORD & AFT. MACH. SPACE
20 LBS. FOR 1/2 L TO 17 1/2 LBS.
13" X 20 LBS. FOR 1/2 L TO 17 1/2 LBS.
17 LBS. TO 15 LBS.
3" X 3" X 6 3/4 LBS.
FRAMES 6" X 3" X 13 LBS. FOR 3/4 L TO 12 LBS.
SPACED 24"
4" X 3" X 10 LBS. TO 3 LBS.
FLOORS 16 LBS. FOR 1/2 L TO 14 LBS.
4" X 3" X 10 LBS. TO 8 LBS.
Marine Engineering

SECTION FORWD & AFT OF MACHINERY SPACE.

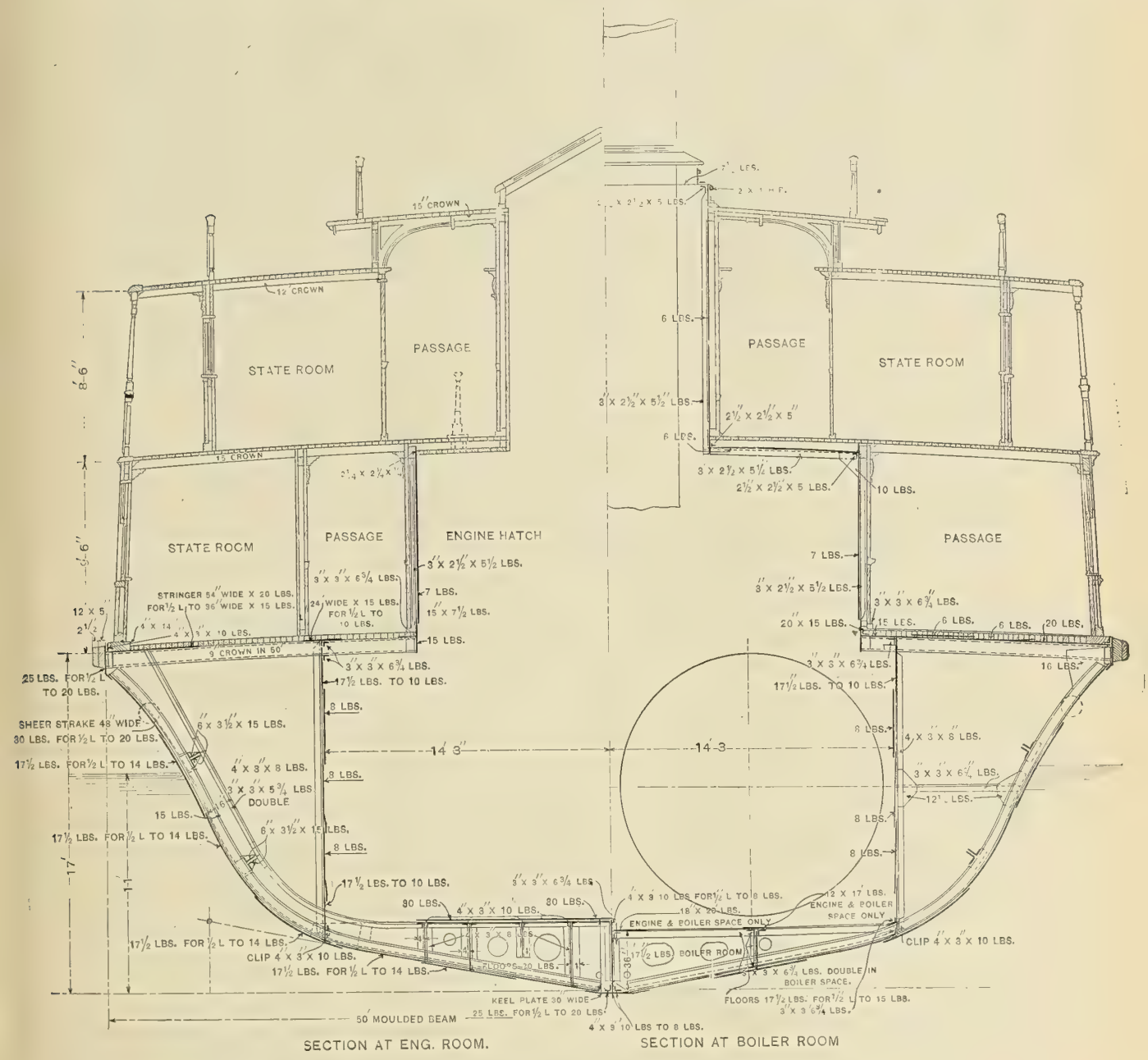
SECTIONS OF THE NEW STEAMER ASBURY PARK, BUILT

MACHINERY.

Two views of one set of the engines of this fast boat are given on pages 500 and 501. There are two sets of four-cylinder, triple-expansion engines, the diameters of the cylinders being 23, 37½, 43, and 43 inches by a common stroke of 30 inches. Piston valves are fitted throughout, one on the high-pressure cylinder and two on each of the other cylinders. The high- and intermediate-pressure cylinders, with pistons between, are made in one casting, and the two low-pressure cylinders,

with piston valves at forward ends, are cast together. A heavy vertical lug cast on the forward side of the low-pressure fits in a recess on the after side of the intermediate-cylinder casting to steady the two castings.

cast-steel crossheads with taper and bolt. The block is bolted to cast-steel shoepiece of the slipper type; the guides are of cast-iron provided with water circulation. The shoe is babbitted front and back, and means are


15" CROWN
12" CROWN
STATE ROOM
PASSAGE
15 CROWN
ENGINE HATCH
STRINGER 54" WIDE X 20 LBS. FOR ½ L TO 96" WIDE X 15 LBS.
24" WIDE X 15 LBS. FOR ½ L TO 10 LBS.
9 CROWN IN 50'
SHEER STRAKE 48" WIDE
30 LBS. FOR ½ L TO 20 LBS.
17½ LBS. FOR ½ L TO 14 LBS.
25 LBS. FOR ½ L TO 20 LBS.
14' 3"
CLIP 4" X 3" X 10 LBS.
KEEL PLATE 30 WIDE
50' MOULDED BEAM
SECTION AT ENG. ROOM.
ENGINE & BOILER SPACE ONLY
BOILER ROOM
FLOORS 17½ LBS. FOR ½ L TO 15 LBS.
SECTION AT BOILER ROOM

BY WILLIAM CRAMP AND SONS SHIP AND ENGINE BUILDING COMPANY.

The cylinders are mounted on steel frames. The engines are designed to turn outward and so the inboard columns are fitted with crosshead slides. These columns are built up of plates and angles, as clearly shown in the engravings, one column supporting each cylinder. On the outboard sides the cylinders are held by two cast-steel I-beams. The columns, both front and rear, are bolted to a cast-steel bed plate with crosspieces which form the main journals. This bed plate is of I-section.

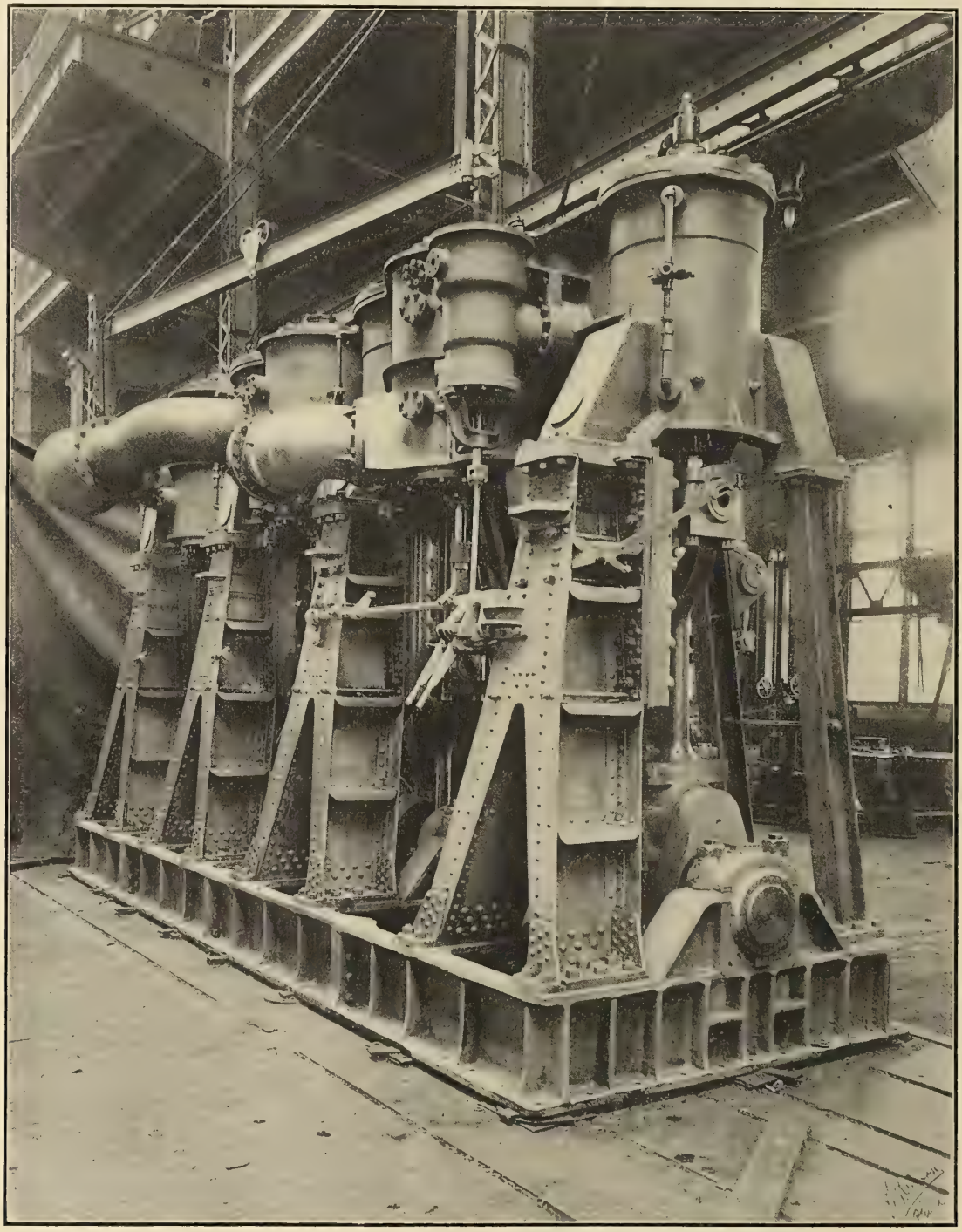
Piston rods are 4¾ inches diameter, and fitted into

provided for taking up the wear. The connecting rods are tapered, forked at the upper ends, and fitted with the usual form of brasses.

The piston valves are fitted with snap rings. The Stephenson double link motion is provided, controlled by a vertical steam cylinder working on the reversing shaft, which is on the outboard side of engine. The eccentric rods are of forged steel bolted to cast-iron straps. Eccentrics are of cast-iron, keyed to the shaft. On the intermediate and low-pressure cylinders there

are two piston valves. Each pair of valve stems is attached to a yoke which has vertical bearing of hexagonal shape, and thus a greater wearing surface is secured. Katzenstein packing is used on rods and valve stems.

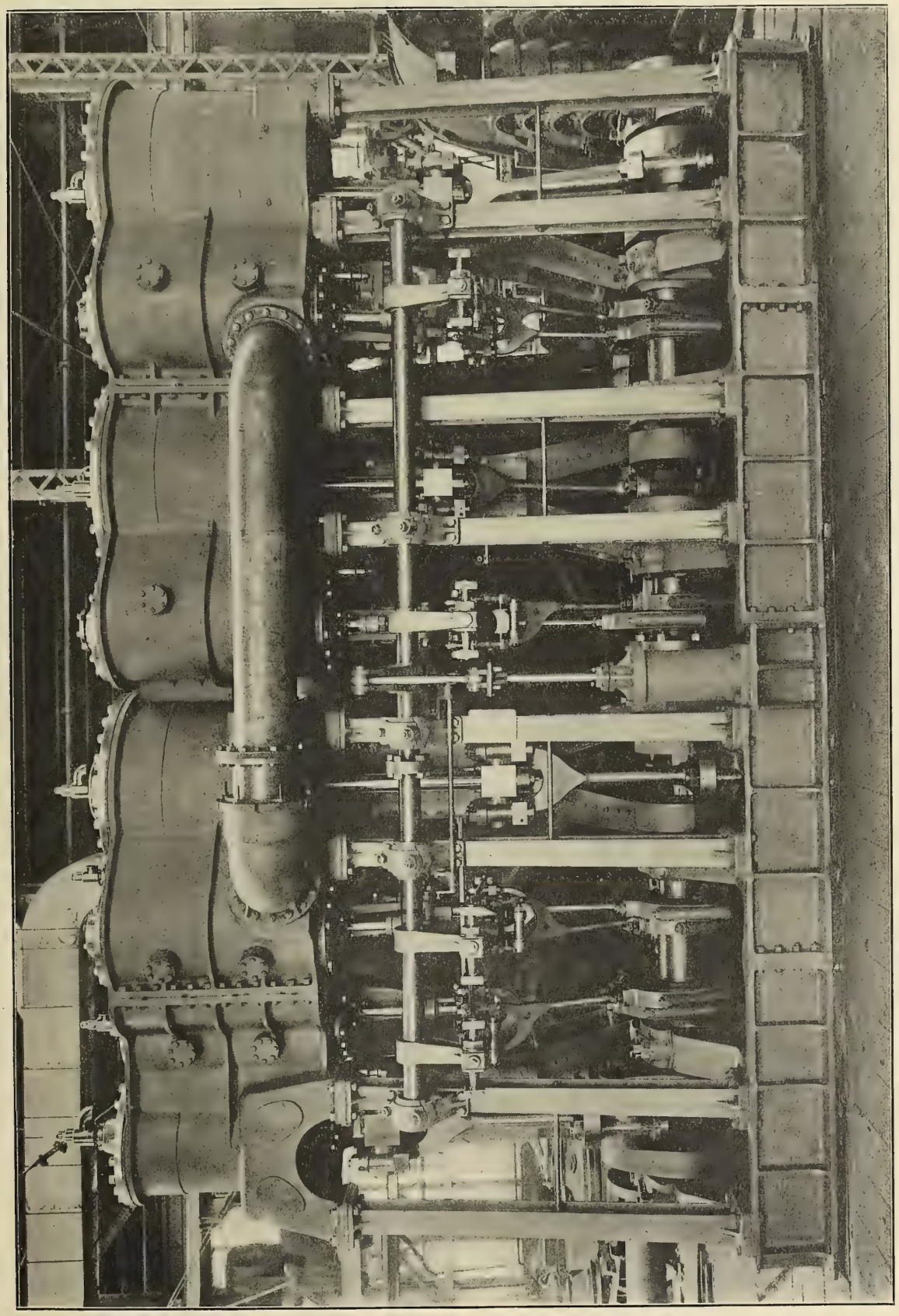
The thrust shaft is fitted with eight collars, between which are seven horseshoe bearings for taking up the forward and astern thrust. These bearings are placed in recesses in the after engine-room bulkhead and are mounted to framing bolted direct to engine bed plate.



PORT ENGINE OF THE ASBURY PARK, THE HIGH-PRESSURE CYLINDER IN THE FOREGROUND.

Crank shaft is of the solid and built-up type; that is to say, webs and crank are made out of solid forgings and these are shrunk and keyed on to the shaft. There are eight journals on each engine, with cast-steel tops. Crank-pin brasses of the usual form are fitted.

A gland is provided at each end of bearing, as the latter is in the form of a box and the shafts may be run in water. The line shaft is in three sections of 10¾ inches diameter, and the propeller shaft is fitted with brass sleeves bearing on the lignum-vitæ-lined stern tube.



VIEW OF OUTBOARD SIDE OF FOUR-CYLINDER, TRIPLE-EXPANSION PORT ENGINE OF THE TWIN-SCREW STEAMER ASBURY PARK.

The outboard bearing is carried by cast-steel brackets. The two propellers are four-bladed, of the built-up type, the blades of bronze and the hub of cast steel.

AUXILIARIES.

Steam exhausts from the inboard side of port engine low-pressure cylinders and from the outboard side of starboard engine into a large, common condenser placed across after end of engine room. This condenser has a steel-plate cylindrical shell, 15 feet long by 5 feet 6 inches outside diameter, and is fitted with copper tubes.

A double simplex vertical Blake air pump is placed on port side opposite the condenser, the dimensions being 10 and 20 inches by 16 inches. This pump is of the "featherweight" type and delivers into the hot well abreast of it. Water is raised, by a Worthington vertical duplex lift pump 10 and 7 by 10 inches, into the heater in the engine room hatch above. From thence the water falls by gravity to the main pump, of the same size and type, and is fed to the boilers. The lift pump may also be used as boiler feed by cutting out the feed-water heater. Into said heater steam from the dynamo and other auxiliaries may be exhausted. These pumps are placed on the port side. A large Blake duplex horizontal 12 and 8⅛ by 10-inch donkey pump is placed above the condenser for fire or other service. On the starboard side there are the following: A vertical duplex Worthington pump for sanitary purposes, 5¼ and 5 by 5 inches; a pump of the same pattern, 6 and 6 by 6 inches, connected for pumping out the bilge; and a centrifugal pump for circulating water through the condenser, driven by a 7 by 7-inch engine.

The filter tank and fresh-water tank are placed abreast of engine room on port side, and on the starboard side is a dynamo room, in which are placed two direct-connected sets of General Electric dynamos connected to engines. The capacity of the two dynamos is 25 Kw. and 8 Kw. In the upper engine room on either side are placed two double Sturtevant engines turning centrifugal blowers for supplying the forced draft of the Howden system to the boilers.

BOILERS.

Steam is supplied by four Scotch boilers arranged in two stokeholds; the after boilers are double-end and the forward boilers are single-end, with a common diameter of 13 feet. The length of the double-end boilers is 20 feet and that of the single-end boilers is 10 feet 6 inches. A passageway recessed in port wing coal bunker leads from the after to forward boiler rooms. Shells are 1 5-64 inches thick, designed for a working pressure of 175 pounds and tested by hydrostatic pressure to 263 pounds. The double-end boilers are fitted with six corrugated furnaces, each 38 inches mean diameter, and the single-end boilers have three similar furnaces. There are three combustion chambers in each boiler. Each chamber of the double-end boilers (into which the furnaces from each end open) is divided by a fire-brick wall. The tubes are 2½ inches diameter outside.

All boilers are fitted with Howden forced draft, nests of 3-inch vertical tubes being placed in the smoke boxes. The donkey boiler, placed on the main deck at the forward port end of casing, is of the vertical tubular type, 60 inches in diameter and 4 feet high.

Steam piping of the main engines is laid in two lines well up above the main deck. On the after side of the engine-room bulkhead a cross between the two lines is fitted. Throttle valves are placed at inboard side of each high-pressure cylinder. All high-pressure steam piping is of copper. There are eight safety valves provided, two on each boiler, with a total area of 102 square inches.

Ashes are hoisted from the stokeholds by small engines placed above the main deck, and are dumped into hand cars. The bunkers are filled through coal scuttles in the main deck.

Under trial conditions when at sea and when burning soft coal, retarders being fitted in the boiler tubes, the *Asbury Park* easily fulfilled her contract requirements and attained a speed of about 20.5 knots.

NAME—Asbury Park. NATIONALITY—American. TYPE—Fast harbor steamer.
LAUNCHED—1903. BUILDER—Wm. Cramp and Sons S. and E. B. Co. OWNER—Central R. R. of N. J.

Length over all	307 ft. 0 ins.	Pitch	12 ft. 2 ins.
" between perps	297 " 3 "	Area, developed, each	33 sq. ft.
Beam at water line	42 " 8 "	**Boilers:** Type	Scotch
" molded	50 " 0 "	Number	two double-end, two single-end
" over guards	51 " 4 "	Pressure, gage	175 lbs.
Depth, molded	17 " 0 "	Diam	13 ft. 0 ins.
Draft, load	11 " 0 "	**Length**, double-end, 20 " 0 "	
Displacement, load	2,000 tons	single-end, 10 " 6 "	
Block coef	0.5	**Furnaces**, each, double-end, 6; single-end, 3	
Tonnage, gross	2,078 tons	" diam., mean	38 ins.
Passengers allowed	2,159	**Tubes**, diam., outside	2 1-2 "
Engines: Number	two	G. S., each, double-end,	48 sq. ft.
Type	four-cylinder triple	single-end,	96 " "
Cylinders, diam	23, 37 1-2, 43, and 43 ins.	" total	288 " "
Stroke	30 "	H. S., each, double-end,	1,774 " "
Valves	all piston, 1 on H. P., 2 on each other	single-end,	3,833 " "
Shafting	10 3-4 ins.	" total	11,214 " "
Propellers, four blades each, built-up		H. S. ÷ G. S.	39
Material	bronze blades, cast-steel hubs	**Trial:** I. H. P., about	6,000
Diam	9 ft. 6 ins.	R. P. M.	190
		Speed	20.5
		I. H. P. ÷ G. S.	4.86
		H. S. ÷ I. H. P.	1.87

Address Missing.—If the correspondent "Amateur," of San Francisco, will send his address his question will be answered by mail.

Cancel Crescent Cruiser Contract.—By order of Assistant Secretary of the Navy Darling, the government contracts for the protected cruiser *Chattanooga* and torpedo-boat destroyers *Nicholson* and *O'Brien* have been canceled. These vessels will be taken from the yard at Elizabethport, N. J., and completed at the government shipyards.

INTERNAL LUBRICATION OF MARINE MACHINERY.

BY H. C. DURYEA, LIEUT. U. S. N.

The loss due to the friction of pistons, plungers, valves, and their respective rods at stuffing boxes, forms a large part of the total loss caused by friction; and the question of keeping these internal parts in proper condition to reduce this loss to a minimum and prevent their wear warrants considerable attention by those to whom the care of marine machinery is entrusted.

New difficulties in lubrication have been met in the use of high steam pressures and superheated steam, due to the very high temperature at which the ordinary lubricants are vaporized. The use of greater piston speed and pressures on wearing surfaces likewise has added to the problem.

Remedies suggested to secure the nearest to the desired conditions are:

1. Selection of best materials the friction between which is a minimum.
2. Efficient design.
3. Good and accurate workmanship.
4. Care and treatment to prevent the deterioration of the wearing surfaces.
5. Lubricants.

PROPER MATERIAL.

The materials for the internal wearing parts should be such that the coefficient of friction is as small as possible. Then a very smooth and hard surface can be obtained and one that requires relatively little lubrication besides the moisture of the steam. Hard, cross-grained cast-iron wearing on itself seems to meet these conditions better than any other practical combination of metals. When the cylinder and valve-chest liners are made of this material and with cast-iron rings well fitted, an extremely hard and smooth surface is the result without applying any lubrication but the moisture of the steam. The material should be as hard as it is possible to work it, the efficiency of the wearing surface depending in a great measure on its hardness.

EFFICIENT DESIGN.

The following points of design will effect smooth running very materially:

The spring rings or snap rings should exert a uniform and not an excessive pressure, and their surfaces should not be too great. Thus, if a ring 1 inch wide will be efficient in keeping a piston tight, making the ring 2 inches will only add friction.

Fitting relief rings on slide valves and balance pistons on piston valves always reduces friction and is the general practice of to-day.

The framing and other parts of the engine must be properly braced and stiffened to guard against vibration and the movement of the ship.

The stuffing-box packing should be designed to allow some side play, so as to follow the rods when they become somewhat out of line.

WORKMANSHIP.

Good workmanship will insure all parts being in line, all surfaces true, and all parts accurately fitted together. This includes boring the cylinders true, and finishing the valves and seats to a true surface and the rods to a uniform section.

If there are any material discrepancies in these points, good results cannot be expected to follow.

CARE OF SLIDING SURFACES.

This is accomplished by keeping all parts in line, preventing rusting, pitting, and scoring of cylinders, flats in rings or rods, and cutting of all wearing surfaces.

If cylinders or rings are allowed to rust, the true surface is at once destroyed and small particles of rust will grind and cut any of the wearing parts. Rusting in the cylinders is caused by the presence of both air and moisture. Moisture may be removed by well draining the cylinders and all steam pipes connected therewith; by the avoidance of pockets that cannot be drained of water; and by running the condenser for some time after engines are stopped, so that all possible vapor is drawn out of engines. When engine has thus been efficiently drained the low-pressure exhaust should be kept closed, especially if condenser is to be run at any time. In case there is no exhaust valve and it is desired to run the condenser, it is advisable to put the low-pressure valve on its center and thus prevent the vapor from condenser backing into cylinder and causing rust. Leaky stop and throttle valves will, of course, present conditions to allow rusting.

To keep out air, all parts of engine should be kept closed. Close the drains which open to the atmosphere, indicator cocks, etc., as soon as the engine is shut down. The cylinders of auxiliaries are most likely to suffer from rust due to leaky or partly closed valves, open drains, and the presence of various pockets where water can collect.

When engines are to stand unused for more than a couple of days, and after any lengthy run, the cylinders should be opened and wiped out with kerosene. This removes all rust, moisture, or other deposit that may have collected. Then adding a coat of vaseline will protect the surfaces from further rust or corrosion, as well as giving them a good lubricant.

Pitting in cylinders and internal surfaces is caused by acids which may be contained in impure oil, or from the action of oily deposit consisting of dirt, oil, and rust. Air collecting in pockets and becoming heated may also cause this.

Scoring is caused by hard particles left in the cylinders, and by the edges or ends of the rings nipping cylinder walls, resulting from countersunk bolts let in too far, shoulders worn in cylinder when piston does not overrun, or rings overrunning counterbore, due to lack of adjustment. Slightly rounding off edges of rings might prevent nipping, and providing efficient keepers for the ends will prevent ends vibrating or rings nipping walls. Excessive pressure on some parts may cause the surface to abrade and produce a flat. If rings do not fit well the wear will only be on certain portions; for although the ring in a manner adjusts itself, yet when moved at all the fit becomes worse than ever.

The piston rod being out of line will also cause excessive wear on one side of cylinder and piston rod. When boilers foam, particles of dirt contained in the boiler water pass into the engines and there raise havoc with all moving surfaces.

LUBRICANTS.

Vegetable or animal oils must never be used, on account of the acids, which, being easily driven off by heat,

cause corrosion in the boilers. Mineral oils are largely used, but have a bad effect on the heating surface of boilers, causing lack of efficiency, burning, etc. Oils too freely used also cause piping, pump valves, and seats to deteriorate, joints in piping to leak, condensers to become less efficient on account of oil deposit, and in general cause an increase in repairs and falling off in economy.

With very high pressure or superheated steam ordinary oils are vaporized, or at least their lubricating value is greatly reduced, so that, as in the case of gas engines, lubrication has become a most important question. When somewhat moist steam is used the moisture in the steam acts as a lubricant, especially with cast-iron. With parts well fitted and steam not too dry, vertical cylinders will run satisfactorily without any lubricant except that applied when cylinders are opened; but a satisfactory lubricant will lessen the friction and wear very materially.

Flake graphite has the peculiar properties of not being affected, either chemically or physically, by any temperature encountered in a cylinder. It is not easily carried away from the wearing surfaces, can stand any pressure, and requires only an infinitesimal clearance space between surfaces. It has a high lubricating value and hardens and improves the wearing surfaces by filling up all the minute cavities and irregularities in the surfaces, giving, in a short time, a beautiful, hard-polished surface which requires relatively little lubricant.

Graphite may be applied in the following manner: Whenever cylinders or valves are overhauled, mix graphite with vaseline before applying to the surfaces, which insures a general distribution. On starting up, introduce graphite through an oil cup or indicator pipe. This can be done in a dry state, using an oil syringe, or the graphite can be mixed with water and put in just like oil. Adding it to cylinder oil adds to the lubricating value; but if best results, viewed from the standpoint of boilers and condenser as well as engines, are to be obtained, no oil should be introduced into any steam cylinder on board ship. While running, graphite can be added in the same way; but very little is needed, since it quickly distributes itself over the surfaces and, not like oil, it remains there. Whenever there are indications of the cylinder walls "squealing," a little graphite should be added. Some cylinders lubricated in this manner, that have not had a drop of oil introduced for years except that which might have come from swabbing rods, on being opened are found perfectly smooth and as bright as mirrors. The surfaces have a very fine coating of graphite, which keeps them from being dry and prevents abrasion.

The same results are obtained with valves and their seats—the surface is made smooth and hard, scores are filled up, and a tight and easily worked valve is the result.

In order that the piston rod may work with little friction in its stuffing box, it must be well lubricated. Most patent metallic packings have an oiling arrangement, but this should be supplemented by swabbing the rods. The addition of a little graphite to the stuffing-box cylinder oil will greatly improve its lubricating value and also serve to develop a hard and smooth surface, which is so essential to steam-tight working.

The packing that allows for side movement will keep the rod from wearing and preserve a tight joint much better than those which do not allow such play. Small rods, such as valve rods and rods of auxiliary engines which in many cases have no separate oiling device, should be swabbed to prevent cutting, or the wearing of the rod to a flat or taper, as well as to reduce friction. The primary feature of keeping a stuffing box tight is to keep a true cylindrical rod, and the peculiar properties of graphite produce a hard and smooth surface.

The small and often delicate secondary valves of steam-pump valve gear are made to fit quite tight, and often they become hot and dry and consequently stick. If oil is used in these it gums on the surface and this causes the valve to stick. Slight rusting also causes cutting, which interferes with proper running. The best treatment for these parts is: (1) Frequent overhauling, wiping off all parts with kerosene to clean, remove, and prevent rust, and supplying graphite to protect and develop the wearing surfaces. (2) Adding a small amount of kerosene, with graphite added, occasionally or when valve does not work properly. Kerosene serves to cut out and prevent rust; it has also no bad effect on the heating surface of the boiler.

It is often stated that pumps will not run without oil, but it is a fact that pumps using oil do not run as well as other pumps in which nothing but a little kerosene and graphite had been used for a long period.

WATER END OF PUMPS.

The lubrication of the water cylinders of pumps is frequently entirely overlooked. A great many pumps receive their lubrication naturally, as in the case of air and feed pumps from the oil in feed water, bilge pump from the oil contained in the bilge. But those pumps working on clean salt water—sanitary, distiller, and auxiliary condenser circulating pumps—do not have these sources of lubrication. Salt will deposit itself in some degree and is at once a cutting agent to plungers and pump cylinders.

Such pumps can be lubricated by placing a little grease mixed with graphite on top of the glands. This at once lubricates the rod and some of the lubricating material will find its way to the surface of cylinder, thus reducing friction and wear. The abnormal wear of plunger rods working in clean salt water may have often been observed.

These notes are the results of observation and investigation of seagoing experience, and as such view the matter from a practical standpoint. There is no doubt but that if the question of internal lubrication were well considered and investigated by those operating marine machinery, great reductions in overhauling, wear and tear, and anxieties in attendance would result.

Wireless Telephone.—By means of his wireless telephone A. F. Collins recently successfully transmitted speech between Hartford and East Hartford, with the Connecticut river intervening. The most successful experiments have been made with water as a connecting medium, and it is claimed that the system is especially useful for ferryboats and other harbor craft, as by means of it messages may be readily sent from one to another, regardless of the weather when the boats might be veiled in fog.

SHIPS OF THE OLD NAVY.

View it how we may, there is something pathetic in the passing of the old navy. The "wooden walls" with their mountains of canvas appeal strongly to a sentiment which is perhaps less easily awakened by the grim steel machines which have taken their place. Thought naturally turns first to the old *Constitution,* whose deeds in the war of 1812 have made for her a secure and undying place in the history of our country, and justify fully the efforts which have been made to give to her bodily form a like enduring presence, even though actually but a small part of the original timber could be preserved. If we attempt the preservation of no other like memento of that age of our history, the *Constitution,* at least, merits our best care, and we may hope that the day may be far removed when the gallant old ship shall finally pass from our view.

FAMOUS UNITED STATES FRIGATE CONSTITUTION, LAUNCHED IN 1797, AND AS SHE NOW IS.
[This and the following five photographs were taken by T. E. Marr, Boston, Mass.]

Between the sailing ship and the modern steamship there grew up, during the transition period of 1840 to 1870, a class of ships known as steam or sail auxiliary, and intended for use with either sail or steam, or even both, according as circumstances might favor. Thus were built the *Wabash, Lancaster,* and *Enterprise.* These vessels with their type have likewise all "passed" and only exist now on sufferance or by reason of glorious deeds associated with the name, as in the case of the *Hartford,* which won undying fame as Farragut's flagship in the naval operations at Mobile bay and elsewhere. The *Wabash, Lancaster,* and *Enterprise* are now used as receiving or training ships, and are thus continuing, in the well-earned quiet of old age, lives of usefulness spent mostly on distant and stormy seas.

The history of the *Constitution* is so well known, and her deeds in the war of 1812 have been made the subject of such extended notice, that only a brief summary of her career may be needed in connection with the view here shown of the ship in her present condition.

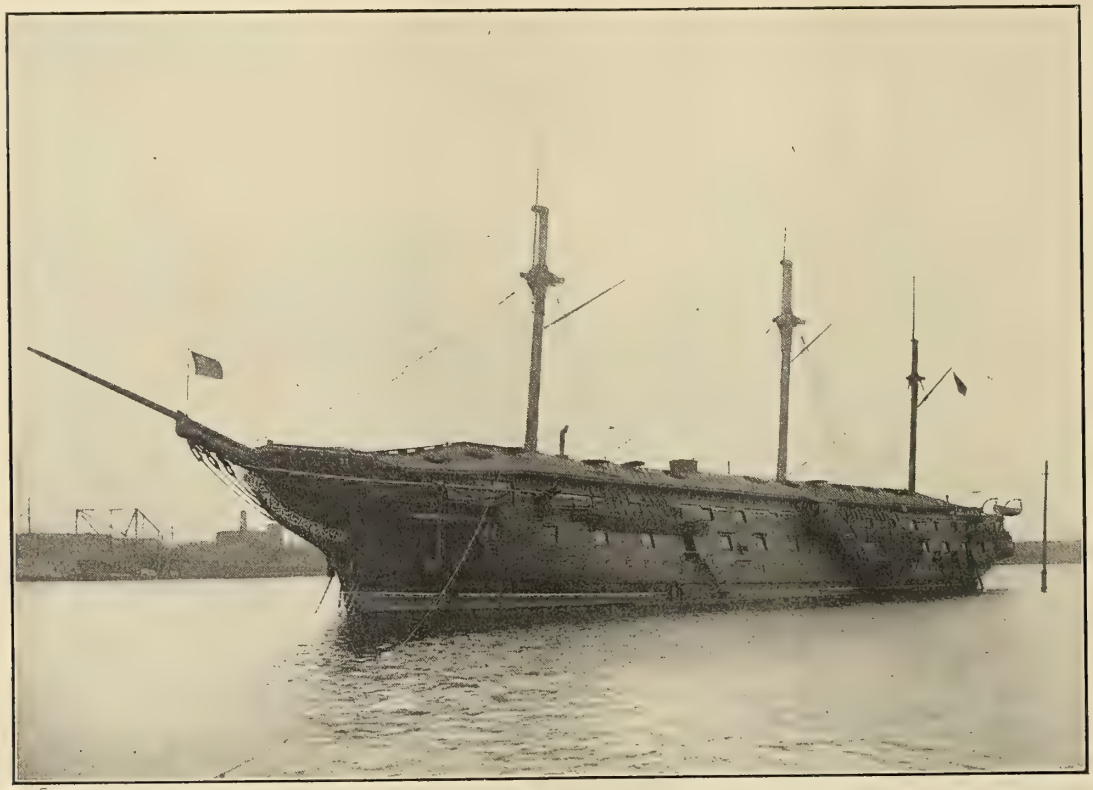
She was launched in 1797 and put to sea the following year for service against the French. During the war with Tripoli, 1801-1805, she was Preble's flagship and took part in three of the five bombardments of the port of Tripoli. In July, 1812, under the command of Isaac Hull, she made her celebrated escape from a British squadron off the New Jersey coast, and shortly after, on August 19, fought the famous battle with the *Guerriere,* which was left a total wreck after an engagement of only some thirty minutes. Later, in December, under Captain Bainbridge, she captured off Bahia, Brazil, the *Java,* after a two-hour engagement in which the British lost some 300 and the Americans 34. Still later, in February, 1814, under Captain Charles Stewart, she captured the *Picton* and a convoy in the West Indies, and in 1815 the *Cyane* and *Levant* after a fierce engagement, noted for the seamanship of the Americans and the unavailing valor of the English. Later she was pursued by a strong squadron which recaptured the *Levant.*

In routine service after the close of the war she was reported unseaworthy in 1828 and was ordered dismantled; but, in answer to Holmes' poem "Old Ironsides," popular sentiment was aroused and she was rebuilt in 1833. She again saw active service in all parts of the world, and was finally laid up in 1855 at Portsmouth, N. H. She was later used occasionally as a

training or practice ship, and in 1877 was again partially rebuilt and crossed the Atlantic bearing the American commissioners and exhibit to the Paris Exposition of 1878. This was her last cruise abroad. Returning she cruised for a time on the home station, and was finally laid up at the Boston Navy Yard, where she still remains, as shown in the adjoining cut.

During the war of 1812 the *Constitution* fought three hard battles and several minor engagements. In Barbary she was engaged altogether in seven bombardments. During the whole period of active service she had but one captain killed and four lieutenants, and is said never to have lost a sail or spar except in battle.

Turning now to the *Wabash,* we pass at one step from 1797 and 1812 to 1854; from the age when the sailing ship was supreme to the age when steam was beginning to be recognized as a factor in navigation; and from the typical wooden sailing frigate to the intermediate type of wooden frigate with nearly full sail power and auxiliary steam power. The *Wabash* was authorized in 1854 and was built at the Philadelphia Navy Yard, being launched in 1855 and commissioned in 1856. Her length on the water line was 262 feet; beam, 51 feet; and displacement at load draft, 4,774 tons. Her cost was about $900,000. Even at this early period there were some far-seeing eyes who saw in the advent of steam an agency which must ultimately displace sails entirely, and it was proposed that these newly authorized ships should anticipate this tendency by being fitted with full steam power and with sails as an auxiliary. The old sailing ships, however, were too firmly secured in the love and pride of their officers, and the proposition was discarded with the intimation that it should be considered a sufficient concession that steam was admitted on any terms whatever. As thus built the *Wabash* was full ship-rigged, with a total sail area about thirty-two times the immersed midship section, which was a ratio only slightly less than that prevailing for full-powered sailing frigates. The form of the *Wabash* was somewhat determined by the fact that her frames were of seasoned live oak in stock at the Navy Yard; and in order that these could be worked up with a minimum waste, the form of the ship had necessarily to be adapted somewhat to the material in hand. The result seems to have been entirely satisfactory, however, and vessels of this class of frigates, consisting of the *Merrimac, Minnesota, Wabash, Niagara, Roanoke,* and *Colorado,* were justly considered as the superior of any war vessels then afloat. On their first cruise abroad vessels of this class were greatly admired and served as models for the constructors of foreign navies.



U. S. AUXILIARY STEAM FRIGATE WABASH, AT ONE TIME FLAGSHIP OF THE EUROPEAN SQUADRON, AND IN ACTIVE SERVICE IN THE CIVIL WAR.

Returning to the *Wabash,* her boilers were of the Martin vertical water-tube type—a form of boiler long since extinct in marine practice. There were four such boilers, each with five furnaces and a total grate area of about 335 square feet and heating surface of 12,540 square feet. There was, of course, but one funnel, fitted so as to telescope down when not in use and thus avoid interference with the sails and gear, as well as improve the appearance of the ship according to the standards of the day. It is of interest to note that a form of feed-water heater was fitted, the heat being derived from the supersalted sea water blown from the boilers in order to keep the degree of concentration down, as was the practice of the day.

The engines consisted of two simple, horizontal, con-

SCENE ON THE GUN DECK OF THE U. S. TRAINING SHIP WABASH.

OFFICERS' PARLOR ON THE U. S. S. WABASH.

densing cylinders, 72 inches in diameter by 36 inches stroke, motion being transmitted from piston rods to crank by a yoke, as in the once popular steeple type of engine. The steam valves were operated by Stephenson links, and cut-off was effected by the well-known Meyer expansion blocks on the back of the valve. The propeller was a true screw, two-bladed, 17 feet 4 inches in diameter and 23 feet pitch, fitted so as to disconnect from the shaft and hoist up in a well at the stern when the ship was under sail.

The steam pressure in the boilers was 13 to 15 pounds, revolutions 40 to 50, I. H. P. about 1,200, and speed 8 to 9 knots under steam alone.

The *Wabash* on her first cruise served as flagship on the home station for about two years, and then went to the Mediterranean for a third year, and returned home in 1859, where she was laid up till the outbreak of the Civil War. She was then placed in commission and saw active service on the coast blockading squadron, in the capture of Port Royal, and in other naval operations of the war. After the close of the war her period of active service was relatively brief. She was given an extensive overhauling in 1870-71, and in 1872 went as flagship to the European station. Returning in 1875 she was first laid up, and then assigned to the Boston Navy Yard as receiving ship, which position she has held since 1877.

The *Lancaster* is another of the ships of the transition period. Authorized in 1857 together with the *Pensacola, Brooklyn, Hartford,* and *Richmond,* she was launched in 1858 and went the following year to the Pacific station, where she remained as flagship until 1867. This assignment deprived her of all participation in the Civil War, in which her sister ships won such great glory. The chief dimensions of the *Lancaster* are as follows: length on water line, 235 feet 8 inches; beam, 46 feet; displacement, 3,290 tons. The boilers were of type similar to those in the *Wabash,* two in number, with seven furnaces each, and with an aggregate of 280 square feet of grate surface and 8,700 square feet of heating surface. The engines consisted of two horizontal, direct-acting cylinders, 61 inches in diameter by 33 inches stroke, fitted with jet condenser. The valves were three-ported slides fitted with Meyer cut-off blocks on the back. The original cost of the *Lancaster* was $568,769. For the original engines a pair of 60-inch by 36-inch Isherwood engines, built during the war, were later substituted, and in 1879-80 the hull was overhauled and remodeled with a ram bow.

U. S. TRAINING SHIP ENTERPRISE, ONE OF THE LAST WOODEN SHIPS OF THE NAVY.

Returning from the Pacific station in 1857, the *Lancaster* was overhauled and fitted with new machinery, as noted, and was then sent to the South Atlantic station, where she remained till 1876. She then returned home, was laid up at Kittery, repaired and saw successive terms of service on the European, South Atlantic, European, Asiatic, South Atlantic, and North Atlantic stations. In 1899 she was assigned to service as a gunnery and training ship for naval apprentices, and still finds usefulness in this work, in which she bids fair to round out a full half-century of honorable and useful naval service.

Passing to the *Enterprise* we have a vessel authorized in 1873, when, in the reaction following the Civil War, the naval *matériel* had sunk to a low ebb. She was authorized in company with seven others, and the aggregate tonnage of the class was not to exceed 8,000

tons nor the aggregate cost $3,200,000. It is of special note that these vessels were defined in the act as "steam vessels of war with auxiliary sail power." The tide had now set strongly toward steam as a motive power, but sails were still retained as an auxiliary. In the *Wabash* and *Lancaster* the relation was reversed. There steam was the auxiliary; now it was sails. The *Enterprise* was built at the Kittery Navy Yard by a private contractor working in co-operation with the government

U. S. AUXILIARY FRIGATE LANCASTER, LAUNCHED IN 1858, NOW A TRAINING SHIP.

officials. The machinery, however, was built at Hartford under separate contract. The length of the *Enterprise* was 185 feet; beam, 35 feet; and the displacement 1,375 tons. The boilers were single-furnace, cylindrical in type, and with an aggregate of 192 square feet of grate surface. The engines were of the horizontal compound type, with cylinders 34 and 51 inches in diameter by 42 inches stroke.

For her first commission, in 1876, the *Enterprise* was assigned to the North Atlantic station, followed in 1879 by special surveying duty on the Amazon and Madeira rivers in South America. She then saw duty respectively on the European, North Atlantic, Asiatic, European, and North Atlantic stations, and finally in 1894 was assigned duty as a Massachusetts state training ship, in which service she is still actively employed.

The *Enterprise* and class were among the last of the wooden construction in the navy. With these vessels the old era closed, and with the *Chicago, Atlanta, Boston,* and *Dolphin,* authorized in 1883, or ten years after the *Enterprise,* the upbuilding of the new steel navy was begun.

The ships here illustrated show the types of naval construction prevailing during the first three-quarters of the past century, and cover the last of the sailing-ship period and the earlier and middle development in the application of steam. The usefulness of these vessels as warships is past, and they remain simply as vestiges of an earlier stage of development, and as illustrating the progress in the art of naval construction during the period of time which they cover.

STEAM TURBINES.—II.*

In closing the discussion Professor Rateau gave in brief the following description of his turbine:

The multicellular turbine in question is constructed by Messrs. Sautter-Harlé and Company, engineers, of Paris, and consists, as shown in Fig. 1, of a series of rotating wheels keyed on the turbine shaft, and separated by circumferential diaphragms held in grooves inside the turbine casing. The latter is in two parts, the section being on a plane which passes through the axis of the turbine. This allows the accurate fitting of the lower half of the system, which is then completed by putting in place the top half of the casing.

The wheels consist of buckled steel plates, conical in shape (see 4, Fig. 1), on the periphery of which are riveted nickel-steel blades, which are further held in place by a band. The fixed blades of the distributors (guide blades) are fitted on the periphery of the diaphragms (see 2, Fig 1), opposite the wheels.

The shaft runs through the diaphragms in bushes of anti-friction metal, with but little play—originally two-tenths of 1 millimeter. The shaft, however, makes its play when this is insufficient. There is no inconvenience attached to the friction of the shaft in the anti-friction bushes. Leakages of steam outside the distributors can only take place through this small windage, the total section of which is comparatively a very small one, owing to the small diameter of the shaft. The space between the wheels and the fixed parts is from 3 to 6 millimeters (.118 inch to .236 inch); there is thus no fear of their coming into contact. Should this happen, however, and a number of blades get broken, they could easily be repaired, even on board ship, as each blade can be removed individually and be replaced by another, fixed by one rivet only.

The steam flows through the diaphragms and wheels from the inlet at *A B* to the exhaust *G*, its pressure decreasing progressively, each successive wheel working under a low fall in pressure. The number of wheels varies from three or four to thirty and over.

The foregoing shows that all loss in efficiency through leakage between the fixed and movable parts has been prevented in a marked degree. It has been stated that with this system of turbine the friction of the wheels in steam leads to a notable loss. This is not the case, and in actual practice, with a turbine the dimensions of which have been carefully calculated, the loss of steam friction is only 3 to 4 per cent. of the power of the machine.

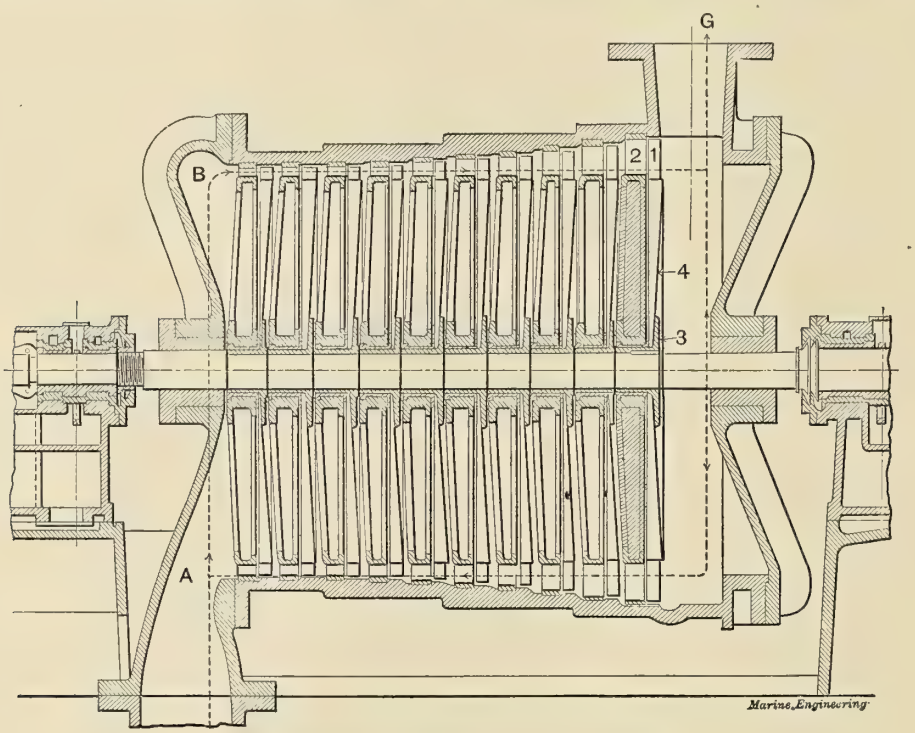


FIG. 1.—SECTIONAL VIEW OF THE RATEAU TURBINE.

The steam consumption is also very moderate, being, it is believed, lower than that of any other similar type of engine. These turbines are calculated with great precision, by formulæ based on theory and completed by experiments on the flow of steam; the difference between the calculated figures and the results obtained at the trials does not generally exceed 2 per cent., thus confirming the formulæ on which the *études* were first made.

The efficiency of these turbines is shown in the diagram, Fig. 2, which gives the results obtained at trial runs, made with the first of three turbines, coupled to a continuous-current dynamo, supplied by Messrs. Sautter-Harlé and Company for the generating station of a

*Discussion of Prof. Rateau's paper on this subject read at the Engineering Conference of the Institution of Civil Engineers, Section V., Shipbuilding, June 19, 1903, and taken from *Engineering*, London.

mine at Penarroya, in Spain. The only motive engines in this station are the three steam turbines in question.

From the diagram, Fig. 2, it will be seen that the consumption of the turbine and dynamo under full load (500 horse power)—the inlet pressure being 8.5 kilograms per square centimeter (120 pounds per square inch), and the back pressure at the condenser .115 kilogram per square centimeter (1.63 pounds absolute)—was 7.03 kilograms (15.5 pounds) of steam per electric horse-power hour; and under an overload, at 640 horse power, with 11 kilograms (156.5 pounds per square inch) and .128 kilogram (1.82 pounds absolute) counter-pressure at the condenser, the steam consumption was only 6.74 kilograms (15 pounds) of steam per electric horse-power hour. These are good results for a 500-horse-power engine, seeing especially that the vacuum at the condenser was not very high. With a high vacuum such as the Hon. Charles A. Parsons can so

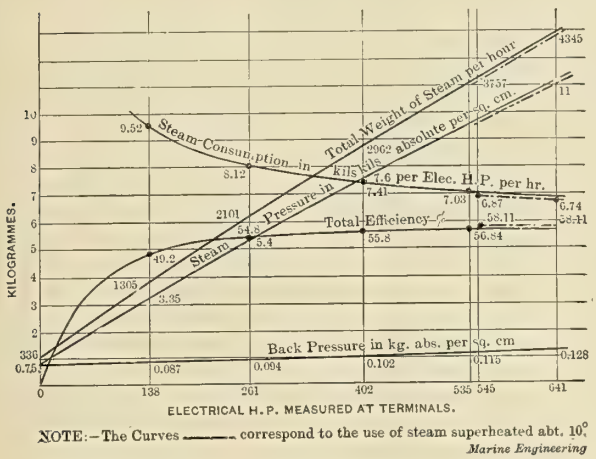

KILOGRAMMES.
Steam-Consumption in kilos
Total Weight of Steam per hour
Pressure in
Total Efficiency
Steam
Back Pressure in kg. abs. per sq. cm
ELECTRICAL H.P. MEASURED AT TERMINALS.
NOTE:—The Curves ——— correspond to the use of steam superheated abt. 10°
Marine Engineering

FIG. 2.—EFFICIENCY CURVES OF RATEAU TURBINE.

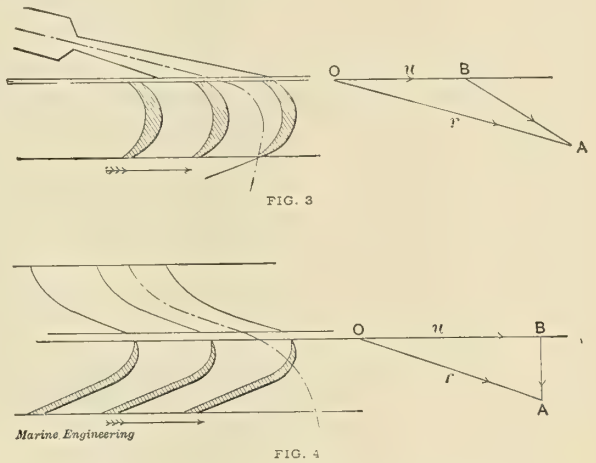


FIG. 3

FIG. 4

VANES OF IMPULSE AND REACTION TURBINES.

readily obtain, say .06 kilogram (0.86 pound absolute) back pressure at the condenser, the above figures of steam consumption would be reduced by 10 per cent. at least, and would be 14 pounds per electric horse power normally, and 13.4 pounds with an overload.

The diagram, Fig. 2, shows further that the total efficiency of the set, which rises to 58 per cent. at full load, remains approximately constant down to below half load; further, the total consumption of steam—the dynamo remaining excited and being self-exciting—does not exceed 336 kilograms (740 pounds) per hour running empty, being thus 10 per cent. lower than at full load. Mr. Rateau believes that no other engine gives such favorable results.

At the same meeting Mr. Cecil West Darley gave the results of trials made with a turbo-pump of the Parsons system, which raised water to a height of from 744 feet to 917 feet, its total efficiency being 31 to 35 per cent. Mr. Rateau has built similar turbo-pumps. One of these is of approximately 200 horse power, and raises water to a total height of 212 meters (700 feet), the output reaching 180 cubic meters (6,357 cubic feet) per hour. The total efficiency was 36 per cent.

About a year ago Mr. Rateau published the results of trials made with a turbo-pump which raised water up to a height of 1,000 feet. Messrs. Sautter-Harlé and Company are building at the present time a similar machine of 500 horse power, to raise water to a height of 1,200 feet, and when working at a pressure of 70 pounds per square inch the steam consumption is guaranteed not to exceed 10.5 kilograms (23 pounds) per useful horse power in water raised. This includes the working of the ejecto-condenser pump.

The question has been asked whether in the Rateau turbines the blades wear out rapidly. The inventor does not see any reason why the wear should be more rapid than in the Parsons turbines, for, owing to the number of wheels, the speed of the steam flow to each does not exceed 200 to 300 meters (660 feet to 990 feet) per second, equal, therefore, to that in the Parsons turbines.

In the turbines with one single wheel, such as the De Laval turbines, for example, the wheel blades wear rapidly; this is due to the fact that the steam, and the solid particles which it may draw with it, strike the wheel at a speed of 1,100 to 1,200 meters (3,600 feet to 3,950 feet) per second. The speed in the Rateau multicellular turbines being the quarter and even the fifth of this figure, it may be supposed that the wear under the striking action of the steam is much reduced, the shock being sixteen to twenty-five times less. Mr. Rateau referred to one of his multicellular turbines which had been working for about a year; it had never been opened, and he supposed the blades were not worn, as he had never found any reduction in its efficiency.

A question was also asked as to the cost of obtaining a good vacuum, or, in other words, what would be the change brought about by causing the vacuum to rise from 26 inches to 28 inches of mercury. Mr. Rateau stated that it was not his place to reply to this question; he only gave the results obtained with the ordinary vacuum. He was, however, quite of the opinion that it is advisable to ascertain what is the best possible vacuum; while, according to theory (as shown in abstract in the consumption formula he had given), on passing from a 26-inch to a 28-inch vacuum, the theoretical consumption per horse power for an inlet pres-

sure of, say, 10 atmospheres, passes from 4.1 to 3.6 kilograms (9 to 7.95 pounds). There was thus a saving of about 12 per cent.; the supplementary work required, on the other hand, of the air and circulation pumps, which had to be larger proportioned, did not exceed 2 to 3 per cent.

The question of a governor for the engine was stated to be independent of the system on which the turbine was built. Any governor could be used for any turbine. As a rule, however, the governing of steam turbines was easier than that of reciprocating engines—first, because the moment of rotation was constant; and, secondly, because the flywheel effect of the rotary masses was comparatively much higher in the turbines than in the reciprocating engines. Therefore a governor which gave good results on a reciprocating engine would give better results still if used for a turbine of equal power. Messrs. Sautter-Harlé and Company have fitted to the turbines the successful type of governor they have designed for their reciprocating engines. This is provided with a speed compensator, and insures for permanent working a constant speed, whatever be the load. For sudden variations in the load, such as removing the full load, the "hunting" does not exceed 4 to 5 per cent.

The Hon. C. A. Parsons had stated that there was no essential difference between impulse and reaction turbines. Mr. Rateau said it was quite certain that they resembled each other, both having rotary wheels and guide blades. There were, however, essential differences between the two, and it was only necessary to open a treatise on hydraulic engines to see that hydraulic engineers attach great importance to the distinction between the two types. Mr. Rateau had not sufficient time to develop the reasons for the distinction, but stated that the speed triangle at the entrance to the wheel was very different in the one case from what it was in the other. Fig. 3 shows the speed triangle and the shape of the vanes of an impulse turbine, and Fig. 4 those for a reaction turbine (the latter in the Jonval type).

As the steam turbines revolve generally too fast for the work they have to perform, means have to be taken to reduce the speed, and one of them is to cause the turbine to work by impulse and not by reaction.

The Hon. C. A. Parsons asked how Mr. Rateau stood with regard to the trials of the *Libellule,* a boat ordered by the French Navy, and which is to be fitted with a turbine of his system. Mr. Rateau replied that it was not the *Libellule* which was undergoing trials at Havre, but torpedo boat No. 243, and these were to test the turbine. The *Libellule,* although provided with a steam turbine, was for the testing of another apparatus which is not yet completed. Preliminary trials were made with torpedo boat No. 243 during the summer months of 1901, and these immediately showed the disadvantages of an internal bearing, which resulted in a considerable oil priming to the condenser. This system of bearing was altered, and the trials were renewed during the summer months of 1902. Several runs were made in the open sea, which proved the perfect working of the turbines, without vibration and without oil priming. The speed contemplated had not, however, been reached so far. This was due to the difficulties met with in the action of the screw propellers, and which existed also in England at the commencement of the trials. The best system of propellers to be used in conjunction with steam turbines was being investigated up to last November, when the matter was dropped owing to an administrative matter, which had to be settled, relative to a special dynamometric device that had been provided for measuring separately the efficiency of the turbine and that of the propellers. The use of this device having appeared dangerous after the unfortunate disaster to the *Cobra,* it had been decided not to resort to it.

The trials are going to be renewed, the navy having taken another method for measuring separately the efficiency of the turbine and that of the propellers.

With regard to the anteriority of Tournaire as to reaction turbines with multiple wheels, Mr. Rateau said he had pointed it out as far back as 1890 in a paper to the Société de l'Industrie Minérale, St. Etienne, in the monthly report of March, 1900. It is stated also in the *Dictionnaire des Arts et Manufactures* of Laboulaye, 1877.

School of Naval Architecture at San Francisco.

With the increased growth of shipbuilding on the Pacific during the past two or three years there has come a correspondingly increased demand for technical training in naval architecture, and until recently there were no courses of study on this subject on the coast.

Last winter a course in naval architecture was established under the auspices of the Young Men's Christian Association Night School, and conducted by Mr. Vicente Legarda, a native of the Philippine Islands, who has spent many years in the Clyde district of the British shipyards. The course opened with a small attendance of apprentices, shipfitters, draftsmen, and carpenters, and has since then gradually grown in numbers. It was necessary to start at the very beginning with most of the men. The classes meet three evenings a week, Monday, Wednesday, and Thursday; the first two evenings are devoted to personal instruction in drawing and calculations, while every Thursday evening is taken up by lectures on naval architecture. The complete course extends over a period of three years.

In the elementary course of the first year the following subjects are taken up: Laying off and fairing, calculations of displacement, center of buoyancy and metacenters, methods of preparing construction drawings including details, also description of the screiveboard.

The advance course includes instruction in the following topics: Ship design, different coefficients, riveting, center of buoyancy, flotation and gravity, stability, strength of materials, ordering materials, etc.

The honors course takes up stability, bilging, oscillation of ships, local and structural strength of the ship, equivalent girder, tonnage, calculations of horse power and propulsion of ships.

Each course begins with the first week of October and ends March 31. A summer class is conducted for those who wish to prepare themselves for the regular work, which lasts from April 1 to July 1. At the end of each session a certificate of proficiency is awarded each student who has passed the final examination satisfactorily.

REAR-ADMIRAL GEORGE W. MELVILLE, RETIRED.

One of the few unfortunate results of the rule of retiring army and navy officers when they have reached sixty-two years of age is that of retiring Rear-Admiral George W. Melville, Engineer-in-Chief and Chief of the Bureau of Steam Engineering, U. S. N. Probably no man in the Navy, and certainly none in the engineering department, has been so conspicuous as this chief for force of character, executive ability, and perseverance, tempered withal with sound judgment. The Navy is losing in him a most valuable man from the active service, yet, according to the former practice of making use of conspicuous men on the retired list, he will doubtless be assigned to work on some advisory board.

REAR-ADMIRAL GEORGE W. MELVILLE, ENGINEER-IN-CHIEF, U. S. N.

Melville is a name conspicuous in Scotch history for energy in supporting the reforms in the days of Henry VIII. and James I., and the succeeding generations of this family did not hesitate to assert their belief even at the instance of death.

In 1804 James Melville, of Stirling, Scotland, landed in New York city, bringing with him a large family of sons; among them was one named Alexander, father of the subject of this sketch, who was born on January 10, 1841, in this city. He was educated in its public schools, then studied at the Brooklyn Polytechnic, and later took a course in higher mathematics in another academy. As his tastes inclined to mathematics and mechanics, he then entered the employ of James Binns, manufacturer and engineer, of East Brooklyn, and here he gained his first practical experience. As soon as the war broke out and the call came for men to uphold the unity of our country, Melville, who was not yet of age, stirred by patriotism and love of country, sought service under the flag and became an officer in the engineering corps of the United States Navy. Then began Melville's active service afloat.

At the time of the outbreak of hostilities there were but 69 vessels of all classes, of which half were sailing ships, in the United States Navy. Seeing the absolute necessity of an efficient blockade of the Confederate coast in order to reduce the rebellion, Gideon Welles, Secretary of the Navy, immediately undertook the assembling of immense blockading fleets, so that at the close of the year 1861 the government, through purchase and construction, possessed 211 vessels, and at the close of the war the number had grown to 600 ships of all classes. It was through the services of such men as Melville, able, resourceful, and possessing indomitable courage, that this fleet was made efficient and the sources of supply to the Confederacy from the outside world were effectually severed.

Melville served on many vessels, his first assignment

being on the side-wheel steamer *Michigan,* on the Great Lakes. He was later assigned to vessels on the Atlantic coast and finally to the steam sloop-of-war *Wachusett.* It was while Melville was on board the *Wachusett* that this ship engaged in one of the most dramatic incidents of the war. She was refitting in the harbor of Bahia, Brazil, in 1864, when there steamed into port the Confederate cruiser *Florida.*

The observance of the international laws in regard to neutral waters should have, of course, prevented any combat taking place in the harbor, yet so intense was the feeling between the crews of the two ships that a Brazilian gunboat anchored between them and the guns of the forts were trained upon them. Captain Collins, of the *Wachusett,* sent a challenge on board the *Florida* for a naval duel to be fought at sea. The two vessels were evenly matched, as the Union ship was of 9 guns and 1,032 tons, while the Confederate had just been turned out from the Liverpool shipyards and carried a battery of two 7-inch rifles and six 6-inch guns. As a commerce destroyer the *Florida* had inflicted most severe damage to American shipping.

The challenge being declined, a council of war was held on board the *Wachusett* as to how to dispose of their antagonist, and Melville suggested ramming her. The objection was raised that the resulting blow would loosen the boilers on the *Wachusett* and sever the steam connections. Melville took the opposite point of view, and closed the argument by stating that it would be necessary for but one man to remain below after the engine was started, and that one would be himself. This plan was adopted, and at 2 A.M. on October 7 the *Wachusett* left her moorings and at full speed dashed into the *Florida,* ramming her on the starboard side abaft the beam, cutting her down 18 inches below the water line. The boarding party completed the victory and captured the surprised crew before they had time to offer much resistance.

Quick action was absolutely necessary before the Brazilian forts or warship should interfere. A hawser was made fast to the *Florida* and the *Wachusett* towed her out to sea, running the gauntlet of the forts, which had been awakened by the noise of the conflict. All this was accomplished in twenty minutes and without the loss of a single life, and the *Wachusett* towed her prize to Hampton Roads, Va., where the *Florida* was sunk.

Regarding this incident, Professor Soley says: "The capture of the *Florida* was as gross and deliberate a violation of the rights of neutrals as was ever committed in any age or country. . . . All that can be said is that it was the independent act of an officer and that it was disavowed by the government." He adds, however, as to the approval by the American people of the act: "The slight regard which, during nearly four years, neutrals had shown for their obligations toward the United States, and the use of their own territories which they had permitted to the Southern cruisers, had aroused in this country a just indignation and a deep-seated sense of wrong and outrage."

Many other interesting and daring incidents in which Melville took part during the war might be given, but suffice it to say that his courage, mechanical ability, energy, and engineering skill were generally recognized throughout the Navy.

In 1873 Melville saw his first Arctic service on board the steamer *Tigress,* which went to the relief of Captain Hall. He there imbued the spirit of the explorer, and six years later, when Lieutenant George W. De Long, U. S. N., started for the North Pole on the *Jeannette,* a bark-rigged steamer of 420 tons, Melville went with him as chief engineer. The story of the long cruise of the *Jeannette,* her final abandonment by officers and crew, of the fearful privations and sufferings of the crew from cold and hunger in those Arctic seas and lands, and the indomitable spirit and perseverance of Melville in searching for his commander, alone and unassisted, until he almost died in his tracks, are facts which have gone down in history to form part of the fearful records in the search for the North Pole. Repeatedly did De Long in his journal give glowing praise to his engineering chief for his resourcefulness, perseverance, and cheerfulness. The *Jeannette* sailed from San Francisco on July 8, 1879, and it was three years afterward that Melville and a few of the survivors returned. De Long and others had succumbed to the fearful hardships after the party had separated in whaleboats to sail across the open sea on their retreat southward; but it is solely to the credit of Melville that all the records and instruments of the party were recovered.

Melville never received any adequate recognition for this service, although ten years later a bill was passed by Congress advancing him fifteen numbers, which was half the numbers often given to men who had served gallantly in the Civil War. This was doubtless due to the friction between the engineers and the line officers of the Navy. It was not, however, for reward that Melville went to the Arctic, but for the real love of exploring; for in 1884 we find him again northward-bound with the fleet sent to the relief of the Lady Franklin Bay expedition. Later he was much interested in General Greely's expedition, although he did not go with him.

These incidents bring the history of Melville's life down to his service on shore. On August 8, 1887, he was appointed by Hon. William C. Whitney, Secretary of the Navy, engineer-in-chief. This appointment was distinctly one based on merit, for if Melville had any politics they were rather Republican than Democratic. He assumed the duties of this office just after the time that the rebuilding of our Navy had occurred; the four Roach cruisers had been completed. The unfortunate criticisms and condemnations of these vessels by Congressional committees which knew absolutely nothing about a steel ship, as is proved by the twenty years' efficient service of these four vessels, had inclined the department to purchase abroad plans for several cruisers. Secretary Whitney decided to change this policy and have the plans drawn for future vessels by members of his own staff. Melville readily and willingly undertook the design of the machinery for the first thoroughly American cruiser, later named the *San Francisco,* and from that time on all machinery for our Navy has been gotten out by the Bureau of Steam Engineering, the aggregate power of engines

constructed or under way amounting to over one million horse power.

As is well known to all readers, a progressive policy has been the keynote of our Navy; not such progression as would run ahead of complete experimental demonstration, but such as is always looking for an improvement in or substitute for existing forms. Melville was early interested in the water-tube boiler. He did not, however, believe in selecting a single type and installing it in all vessels of the Navy, but rather in equipping different vessels with different types, to see by comparison which is the best suited to naval requirements. He was the first engineer-in-chief of any navy to take up the water-tube boiler, and the monitor *Monterey,* built on the Pacific several years ago, was fitted with Ward boilers.

His progressiveness has been shown in many ways, and he has strongly advocated the establishment of an experimental station at Washington wherein the new devices and machines which are brought out might be thoroughly tested and original research carried on for the benefit not only of our Navy but for general shipbuilding. At this point it is well to make note of the fact that Rear-Admiral Melville has at all times kept in touch with our merchant marine and been free to give to shipbuilders and the technical press the information of his department. He advocated publishing the plans of hull and machinery of new warships in the annual reports of the department, and it is to be regretted that this feature was discontinued because of pecuniary reasons.

Melville was solely responsible for the installation of the three screws in the cruisers *Columbia* and *Minneapolis.* In undertaking this design he was advised not to by his friends and co-workers, yet his belief in the system was so strong that he would not be deterred. The results were more satisfactory than even he had anticipated, for the speed obtained by these two ships was one knot in excess of that estimated and gave them a greater speed than any vessel afloat, except torpedo boats, of their day. This custom has been followed by all foreign navies except that of Great Britain, and, although the admiral still favors the system, no further vessels in our Navy have been equipped with three screws.

He at all times has advocated high speed, and when, a few years ago, the question arose of duplicating the design for battleships with a speed of 16 knots, he stood out alone for 18-knot ships, and it was through his untiring efforts, assisted, as he acknowledges, by the shipbuilders and the technical press, that the Board of Construction gave the competitors an opportunity to submit designs for 18-knot ships. These later designs were so eminently satisfactory that the speed of 18 knots was decided upon.

At the outbreak of the Spanish war Melville fitted out two novel types of vessels; one was the repair ship *Vulcan* and the other the distilling ship *Iris,* both of which have proved their usefulness as auxiliaries to the fighting fleet.

Extensive experiments were carried on, under the direction of the engineer-in-chief, with liquid fuel. A model boiler room, representing one on board ship, was fitted up and most exhaustive tests were made with oil as fuel. The report on these experiments has been published and forms one of the most valuable works on the subject.

So far we have touched upon only the professional ability of Melville. His record shows, however, that he has at all times been most aggressive in furthering the interests of the engineers, and the amalgamation of engineers and line officers under the Personnel Bill was largely the result of his untiring zeal. Up to that time engineers were given only a relative rank as professionals, and there was continuous conflict between them and line officers. The duties of the engineer afloat have yearly increased since steam was first used as an auxiliary, and the engineering department has so developed that its officers have larger executive duties to perform. In 1897 the Personnel Board was called together to consider this condition and report to Congress. It was presided over by the then Assistant Secretary of the Navy, Theodore Roosevelt. As a result of its considerations the bill providing for consolidating the engineers with the line officers was favorably reported and eventually passed. With strict justice we believe it is not going too far to state that this result would not have been reached for many years had it not been for Admiral Melville's magnificent work in the administration of his office, coupled with his splendid personality. While there have been setbacks to this system, which aims at giving every officer an engineering training and experience, yet the general results have been so good that Great Britain has recently made a similar move.

If one would inquire of the men who have worked under Rear-Admiral Melville, they would find that he inspires tremendous enthusiasm and loyalty among all. He is a shrewd judge of character and has selected for his assistants men of great ability. Doubtless part of this loyalty is a result of Melville's attitude toward the men, for he at all times gives them full credit for their work. He is too broad-gage a man to desire to detract from his assistants' work and take the credit on himself.

As before noted in these columns, the rear-admiral was relieved from duty on August 8, this year, and thus completed sixteen years of continuous service as head of the Department of Steam Engineering. Fortunately it finds him in robust health, with a prospect of many more useful years of active life before him. In these sixteen years marine engineering has made tremendous strides, largely because of increased demands for ships to carry our commerce, yet such strides have only been made possible through hard work and research of the engineer, and it is to Melville that we may extend our thanks and look with pride for his inestimable service in this direction—a service marked by a never-failing energy, heroism, and enthusiasm.

Data Cards.—Marine Engineering was in no way responsible for or connected with the *Engineering Data Card Magazine,* published last year in Richmond, Va., and now discontinued. So many inquiries have reached this office concerning data cards that hereafter all data which have appeared in special card form in Marine Engineering since July, 1903, will be reprinted on standard 3 by 5-inch cards and sold at a nominal figure to subscribers.

Agreement Between the British Government and the Cunard Line.

An important agreement has been entered into by the British government with the Cunard Steamship Company for the building of two fast mail steamers. At a meeting of the shareholders of the company, Lord Inverclyde explained that they had been called together to obtain sanction to such alterations in the articles of association, and in the capital of the company, as were required to enable the directors to enter into and carry into effect the agreement with His Majesty's government. As they had been advised, the basis of this arrangement was settled nearly twelve months ago; but there had been an immense amount of detail to arrange with the four government departments—the Admiralty, the Post Office, the Board of Trade, and the Treasury—with which they had had to negotiate. Further, they had had to deal with many important questions in their negotiations with the proposed builders of the new ships. From the outset the basis of their agreement with the government had remained as stated in the circular; and as the terms of the actual agreement had not yet been approved by the House of Commons, he was precluded from going more particularly into its provisions. In substance, during the term of agreement the company was to remain a purely British undertaking—British as to its shareholders, British as to its ships, British as to its board and officials, and British as to its management and control. Further, the company was to add at once to its fleet two large steamships of high speed for the Atlantic trade; and these two vessels and the whole of the rest of the fleet were to be held at all times, during the currency of the agreement, at the disposal of the government for either charter or purchase at fair and reasonable rates. In return the government was to lend to the company on approved security the money to pay for the building of these two ships at 2 3-4 per cent. per annum, and they were also to pay the company from the time the new ships began to run £150,000 per annum.

The law for generations had limited the right to carry the British flag strictly to British subjects, and it had provided for forfeiture to the Crown of any vessel upon which this rule was not observed. A company registered in Great Britain was treated for all purposes as a British subject, even if every shareholder or director were a foreigner living outside the jurisdiction of our government. The law being as it is, the government, not unnaturally, in dealing with the Cunard Company, had insisted upon their remaining in the future what they had been in the past—a British company not only in name but in fact. At present not more than 1 per cent. of their capital was held by foreigners. Such foreign shareholders would be entitled to remain in the company for as long as they pleased; but for the future they would accept only fellow-subjects as co-owners with them of their vessels. They proposed to accept the government or its nominees as fellow-shareholders, and to attach to the share to be issued to them such a number of votes as would enable them to prevent any alteration being made against their wishes in the above-mentioned clauses. This agreement was passed.

RELIANCE CROSSING THE LINE AT THE FINISH IN THE SECOND OF THE SERIES OF THE INTERNATIONAL YACHT RACES, AUGUST 25, DEFEATING SHAMROCK III. BY 1 MINUTE 19 SECONDS, CORRECTED TIME.

[Photograph by T. C. Muller.]

TWIN-SCREW CARGO AND PASSENGER STEAMER CARPATHIA, OF THE CUNARD LINE.

STEAMSHIP CARPATHIA.

There has been reported in these pages the introduction of many new ships to the transatlantic trade during this past season, all of which are of English build. One of the latest to enter the New York service is the twin-screw steamer *Carpathia,* of the Cunard Line, built by C. S. Swan and Hunter, and engined by the Wallsend Slipway and Engineering Company, both of Newcastle-on-Tyne. The *Carpathia* is of the intermediate type, and is only fitted with second-cabin and steerage-passenger accommodations, the rest of the space being devoted to carrying cargo. She much resembles the *Ivernia* and *Saxonia* in the Boston service of this line. She is rigged with four pole masts and one stack, and the midship house extends two-thirds the length of the vessel, beginning directly aft the foremast. There are three deck houses on top—the forward one for officers' quarters, the main one just aft the mainmast, and the after one at the after end of the midship house. At the break of these houses are hatches to the cargo space below. The second-cabin accommodations are located amidships on the bridge and shelter decks. The dining saloon is forward on the shelter deck, paneled in ivory, white, and gold, the furniture being of mahogany and upholstered in bright tapestry. The dome is of stained glass, and above this is a large fan, electrically driven, for insuring abundant supply of fresh air. The pantries are amidships, and the galleys, baker shop, etc., are on the port side of the shelter deck. Above the dining room is a library well equipped with writing tables, lounges, and bookcases. It is entered from the main hallway, from which the stairs lead to the deck below. The smoking room, which is on the after part of the promenade deck, is paneled in walnut and comfortably fitted. There is, in all, accommodation for 200 passengers in this second cabin.

The third-class accommodations are well equipped in comparison to the practice of a few years ago. On the upper deck is a large dining saloon, well fitted up and well lighted. On this deck there are also provided a ladies' room and a smoking room. The accommodations are ventilated and heated throughout by mechanical means. Fresh air is forced through large pipes into various compartments by means of thermo tanks, consisting of large fans driven by electric motors, which pass the air over coils. In winter time these coils are supplied with steam.

The *Carpathia* has been found to be a very comfortable boat in rough weather. The accommodations for the officers, as above mentioned, are on the bridge deck, and the seamen and firemen are under the bridge deck on the port side, and the stewards are at the forward end of the upper deck. Cargo is handled by Wilson winches. A windlass is placed on the weather deck forward, and warping capstans are at both ends of the vessel.

MACHINERY.

The builders of the engines have endeavored to make this a most economical job. There are two sets of four-cylinder, four-crank, quadruple-expansion engines, and the arrangement of the cylinders and valves is as follows, from forward aft: piston valve, high-pressure cylinder,

low-pressure cylinder; balanced slide valve; piston valve, second intermediate-pressure cylinder, first intermediate-pressure cylinder, and piston valve. Each cylinder and its valve is a single casting and is supported on cast-iron columns front and back. There are cross columns between the engines at either end. The air pump is worked from the second intermediate crosshead, and the condenser shell is made of plate and is supported by brackets cast on two of the back columns. The crosshead has guides on front and back columns, provided with water circulation, and is of the usual type. The pumps; ballast pumps, and an auxiliary condenser for handling the condensed steam for deck and auxiliary machinery. There are two sets of Allen compound engines, each direct-connected to a 450-volt, 100-ampere electric generator running at 305 revolutions. These are placed on the main deck over the after end of engine room.

The 7 single-end Scotch boilers are fitted with Howden's system of forced draft. There are two fans placed in the engine room, one on either side, and each is driven by an Allen simple engine; a spare engine is at-

LOOKING DOWN ON THE WEATHER DECK FORWARD ON BOARD THE CARPATHIA.

shafting is from Armstrong, Whitworth and Company and is of hydraulic-forged fluid compressed steel. The guides for the valve stems are in the form of brackets, forming part of the reversing shaft bracket, and thus independent of the cylinder. To each cylinder are fitted Ripper's mean-pressure indicators, by which the mean effective pressure in each end of the cylinder may be read through the gauges placed on the engine-room platform.

The auxiliaries consist of two sets of Weir feed pumps working in conjunction with Weir patent feed-water heater; centrifugal circulating pumps; two evaporators; auxiliary feed pumps; fresh- and hot-water sanitary tached to each shaft in case of breakdown. The boilers work at a pressure of 210 pounds and are all placed in one large boiler room with two stokeholds. There is one funnel of large diameter with total height of about 120 feet above grate bars. A Crompton ash hoist is fitted in each hold, which consists of a long tube, its lower end being connected to the condenser. In this is placed a piston, to which is attached a wire cable running over sheaves and down the ventilator. To raise the ashes, the bucket is hooked to the lower end of this wire, the valve connected to the condenser opened, and a vacuum formed behind the piston draws the piston down at once, raising the ashes. An automatic device is attached whereby the

valve is closed when the ashes are raised to the desired height and the ashes dumped on the deck. The device is, indeed, most simple, easy to install, requires but very little space, has no parts to get out of order, and is noiseless. In case it is desirable to operate it when the condenser is not running, a vacuum is created by a steam nozzle. It is understood that the *Carpathia* is running very economically, averaging for several trips a horse power on 1.3 pounds of coal per hour.

THIRD CABIN DINING SALOON.

SECOND CABIN DINING SALOON ON THE TWIN-SCREW STEAMER CARPATHIA

Unfortunately, owing to the rules of the Cunard Com-

pany, no dimensions of machinery or hull, other than those given in the appended table, are obtainable.

Length over all	558 ft.
Breadth	64 " 3 ins.
Depth	40 " 6 "
Gross tonnage	13 555 tons
Displacement at load draft	24 000 "
Dead-weight carrying capacity	12 500 "

New Steam Yacht Czarina.

One of the largest steam yachts to be added to the fleet of American-built boats this season was launched on April 4 from the Crescent Shipyard, Elizabeth, N. J., and was christened the *Czarina*. She was built to the order of Mr. Charles S. Bryan, of New York, according to his ideas for having a specially heavily-built vessel which might be converted into a gunboat without the necessity of having strengthening plates fitted under

LOOKING FROM THE BOW ON BOARD THE CARPATHIA, SHOWING ARRANGEMENT OF WINCHES AND HATCHES.

Engines: Type	4-cylinder, quadruple-expansion
Cylinder diameters	26, 37, 53, and 76 ins.
Stroke	54 ins.
I. H. P.	9,000
Valves	piston, except on L. P.
Boilers: Number	7
Type	single-end Scotch
Steam pressure	210 lbs.
Furnaces	3 each
Draft	Howden

her decks. The armament which she is prepared to carry would consist of two 3-inch rapid-firing guns, one starboard and one port, two 6-pounders, one mounted forward and the other aft, all mounted on the cabin deck; and four machine guns placed on the bridge deck. The over-all length of the *Czarina* is 172 feet, and other dimensions as to hull and engines will be found in the accompanying data card.

The arrangement of the cabins is well shown in the plans on page 522. There is but one deck house, extending for 100 feet in length. This is made entirely of mahogany with panels inside and outside. The music saloon is at the forward end and is fitted with heavy

plate glass windows and Venetian blinds with portable stone shutters. From the entrance hall, stairs lead to the main saloon below, and a doorway at the left hand opens into the owner's room, which extends the full width of the deck house and has a bath room adjoining. Aft of the collision bulkhead on the main deck is a large state room, entered through a passageway, from which open the locker space and toilet room. The main saloon has a library and large couches, which may be used for beds, aft of which are two large bed rooms, toilet, and state room. The central part of ship and deck house are entirely devoted to engine and boiler space. The dining saloon, pantry, and galley are at the after end of house, and directly below are the officers' quarters, consisting of state rooms, mess room, and toilets. The crew's quarters are at the stern.

HULL SPECIFICATIONS.

The keel is of rolled bar iron, 1 1-4 inches thick by 6 inches deep, and is made up in lengths of 15 feet. The stem is also of rolled bar iron, 1 1-4 inches thick by 6 inches deep. The stern framing is of the best quality of forged steel, with stern post, rudder post, shoe, and arch in one forging. The stern post is 2 1-4 by 5 1-2 inches, with at least 1 1-2 inches of metal around the hole for the stern tube. The rudder post is 2 1-8 by 5 1-2 inches, with gudgeon, etc., forged on.

The frames are angle bars, 2 1-2 by 2 1-2 inches by 4.1 pounds, spaced 22 inches apart. Reverse frames are angles, 2 1-4 by 2 1-4 inches by 3.6 pounds, and extend 6 inches above the bilge stringer. In the machinery space they are double across the tops of floors, and every alternate one is carried up to the deck. There are also three belt frames in the machinery space. They are made of 8-pound plate, 9 inches wide, and fitted on the inboard edge with two angles 2 1-4 by 2 1-4 inches by 3.6 pounds.

The floor plates are placed on every frame and are of 10-pound plates, 21 inches deep. In the engine space and under the thrust bearings they are of 12 1-2-pound plate. The center-line keelson is made of 12.5-pound plates, 24 inches deep, with continuous bulb angles, 6 by 3 inches by 3 pounds, on top of floors. There is a side stringer on each side, of double angles, 2 1-2 by 2 1-2 inches by 4.1 pounds, connected to the stem by gusset plates 36 inches long by 10 pounds. The inner bottom is formed of 7.5-pound plate. In the wake of the tanks 10-pound plating is used. The plates are flanged on top and connected to the outside plating by 2 1-2 by 2 1-2 inch by 4.1-pound continuous angles, and to the floors by angle clips 2 1-4 by 2 1-4 inches by 3.6 pounds.

There are four water-tight steel bulkheads with angle staples at the keelson and stringers. The plating used is 5 pounds and 7 1-2 pounds. The angle stiffeners, 2 1-2 by 2 1-2 inches by 4.1 pounds, are spaced 27 inches apart. There is one horizontal stiffener on each bulkhead, level with the lower deck beams. It is formed of double angles, 2 1-2 by 2 1-2 inches by 4.1 pounds.

The coal bunker is formed of 5-pound plates stiffened by angles, 2 1-4 by 2 1-4 inches by 3.6 pounds, spaced 22 inches apart. There are four coal scuttles, 16 inches in diameter.

The deck beams are 4 by 3 inch by 7.1-pound angles. The main deck stringer plate is 20 inches wide by 10 pounds for half the length amidships, tapering down to 15 inches by 10 pounds at the ends. It is secured to the sheer strake by 2 1-2 by 2 1-2 inch by 4.1-pound angles.

There is a steel deck of 5-pound plating over the engine and boiler rooms and also over the coal bunker. The outside plating is built up in six strakes, in and out. The sheer strake is about 36 inches by 15 pounds for half the length and 12 1-2 pounds at the ends. The garboard strake is 27 inches wide by 14 pounds. The bottom and bilge strakes are 12 1-2 inches wide by 10 pounds, and the remaining strakes are 10 pounds.

The rudder is made of a wrought-iron frame forged in one piece. The stock is 3 3-4 inches diameter at the head and 2 inches diameter at the heel. The rudder frame is filled in with white pine and rosin and covered with 7 1-2-pound plates.

The deck planking is of well-seasoned white pine 2 1-2 inches by 2 1-2 inches. A steam steerer, No. 112 1-2, with a 3 1-2-inch engine in the engine room, was furnished by Williamson Brothers. The steering wheel is of hard wood, inlaid, 36 inches diameter. The wire rope running to the tiller is 1-2 inch diameter. The quadrant is formed of angles and wrought-iron arms. A spare tiller has been so arranged that it can be instantly connected, should the occasion demand it.

There are four boats and one liferaft, as follows: one 24-foot motor boat, one 24-foot cutter, one 20-foot gig, one 14-foot dinghy. The liferaft is of steel.

There is a supply tank, with a capacity of about 3,000 gallons, located in the forward hold. It is made of 3-16-inch steel galvanized. There is a fresh-water tank, with a capacity of 110 gallons, located in the deck house above the boiler room. This is made of 10-pound steel plate galvanized.

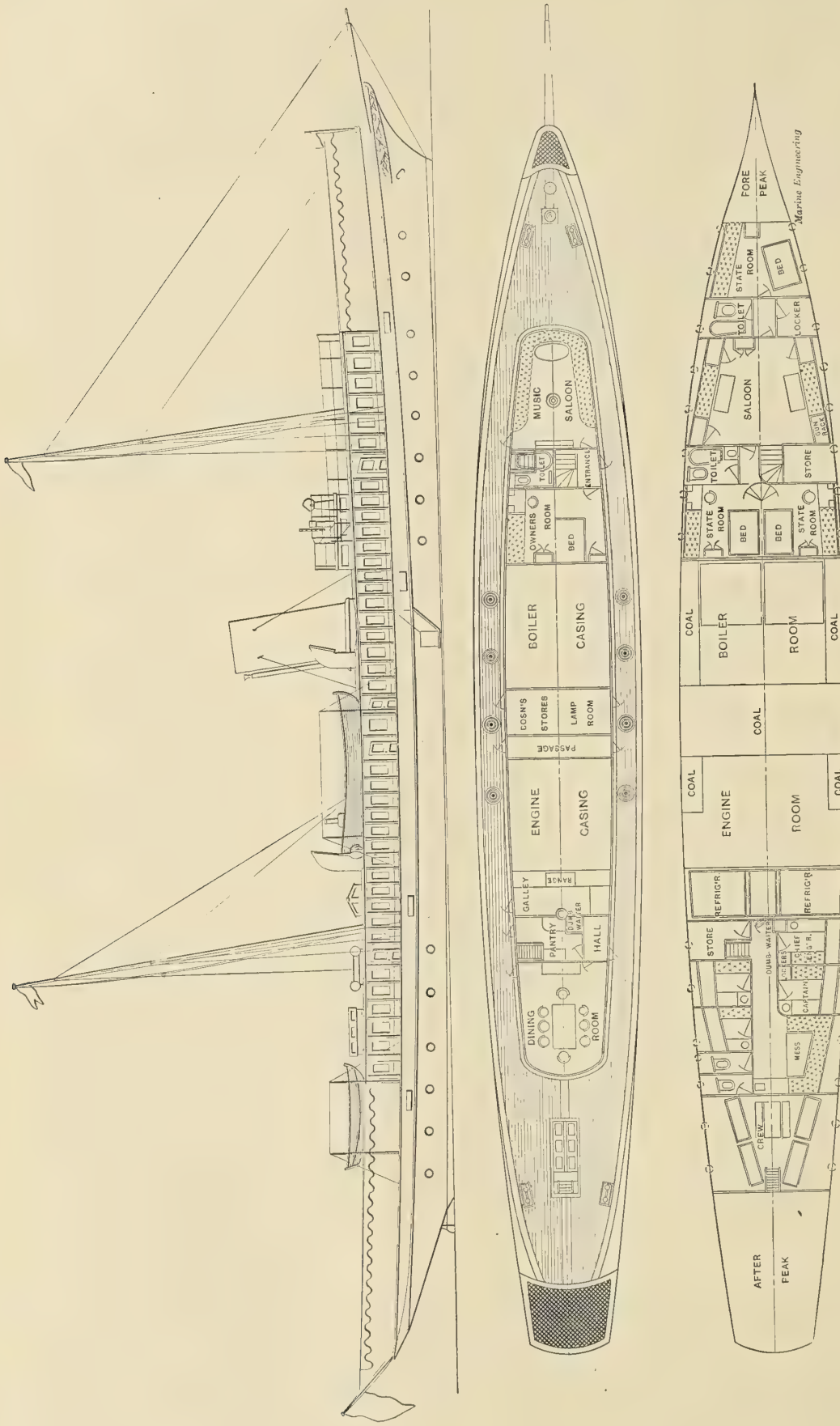
MACHINERY.

The vessel is driven by a vertical, triple-expansion engine of about 1,800 indicated horse power; the cylinder diameters are 14, 22, and 36 inches, the common stroke being 24 inches; the main valves on the high-pressure and intermediate are of the piston type, and the low-pressure is fitted with a double-ported slide valve; all are worked by Stephenson link motion with double bar links fitted with steam reversing gear. The front columns of the engine are of forged steel, and the back columns of cast iron resting on condenser, which forms part of the engine framing.

All pumps are independent of the main engine and are of the Davidson make, consisting of the following: one vertical beam air pump, having one 7-inch steam cylinder, two 11-inch air cylinders, with a stroke of 12 inches; one vertical duplex feed pump, 7 1-2 and 4 1-2 by 8 inches; one vertical duplex donkey pump, 7 and 4 1-2 by 8 inches; two horizontal single-cylinder sanitary pumps, 3 and 4 by 4 inches.

The yacht is well equipped with other auxiliaries, such as refrigerating and ice-making plant and electric lights. A searchlight is placed on the bridge, and a rainbow of incandescent bulbs runs from bowsprit to the after rail, leading over foremast and mainmast heads. A row of bulbs has also been placed from the awning-ridge rope as well as the smokestack.

Two Mosher boilers furnish steam at 250 pounds pressure. The principal elements consist of a steam drum, 32 inches in diameter by 8 feet long, placed at



OCEAN-GOING STEAM YACHT CZARINA, BUILT AT THE CRESCENT SHIPYARD.

the front and top; a water drum, 24 inches wide by 16 1-2 inches high by 8 feet long, placed below at the back of boiler (one-half of it is almost semi-circular, and the other half, in which the tubes are inserted, is of much greater radius); and between these two drums extend the water tubes, 1 1-2 inches outside diameter and 533 in number. The steam drum is supported by return pipes which are run down under the base and along each side of the grate back of the mud drum. The tubes in this boiler are so curved that all of one vertical nest are in line with a plug in the front of the drum; thus, by the removal of the plug, the tubes may be withdrawn or replaced through these openings. Five vertical rows of tubes may be withdrawn through a single plug hole.

Steam is taken from the main steam drum through a dry pipe and then through a superheater back of boiler into main steam pipe for engines.

Above the boiler, and mounted on the same casing with it, are air-heating tubes for heating the air supplied the boilers on the induced-draft system. The tubes are inclined in the same direction as the water tubes, and exhaust gases circulate round them before reaching the fan which exhausts them to the uptake.

NAME—Czarina. NATIONALITY—American. TYPE—Steam yacht.

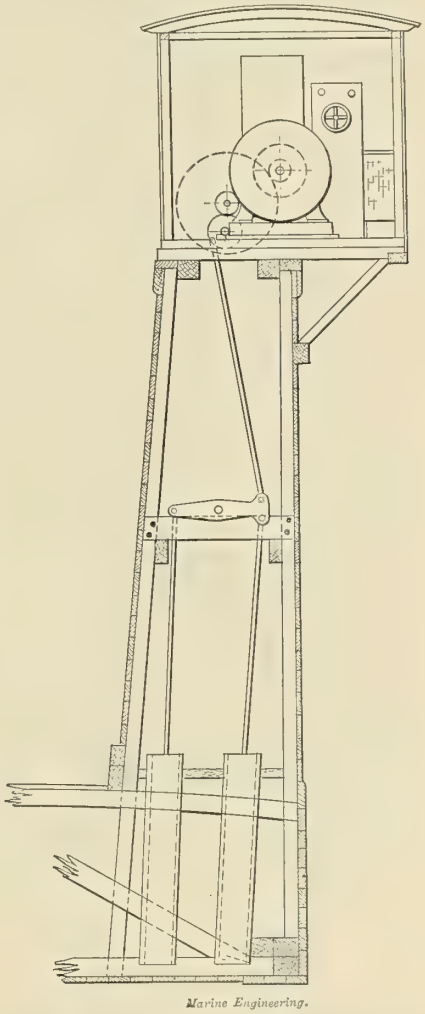
LAUNCHED—1903. BUILDER Crescent Shipyard. OWNER—Charles S. Bryan.

Length over all	172 ft.	Stroke	21 ins.
" between perps	140 "	I. H. P.	1,800
Beam, molded	22 "	Steam pressure	250 lbs.
Depth	12 " 6 ins.	**Boilers:** Number	two water-tube
Draft	9 " 6 "	H. S., two	2,720 sq. ft.
Displacement	300 tons	G. S., "	80 " "
Engines: Number	1	Tubes	1 1-2 in. O. D.
Cylinder diams	14, 22, 36 ins.	" number, each boiler	533

Electrically-Operated Floating Dry-Dock.

The balanced floating dry-dock, photographs of which are shown herewith, was built by James Tregarthen and Son Company, foot of Seventh street, East river, New York. It is of the well-known balanced type, which has demonstrated its fitness for a great variety of dry-docking work and is justly so popular in this country.

The dock is 260 feet long on keel blocks, 186 feet 4 inches length of body, and is 85 feet wide. It has a depth at center of 10 feet 4 inches, and a height of wings of 34 feet, sufficient to take a draft of 20 feet



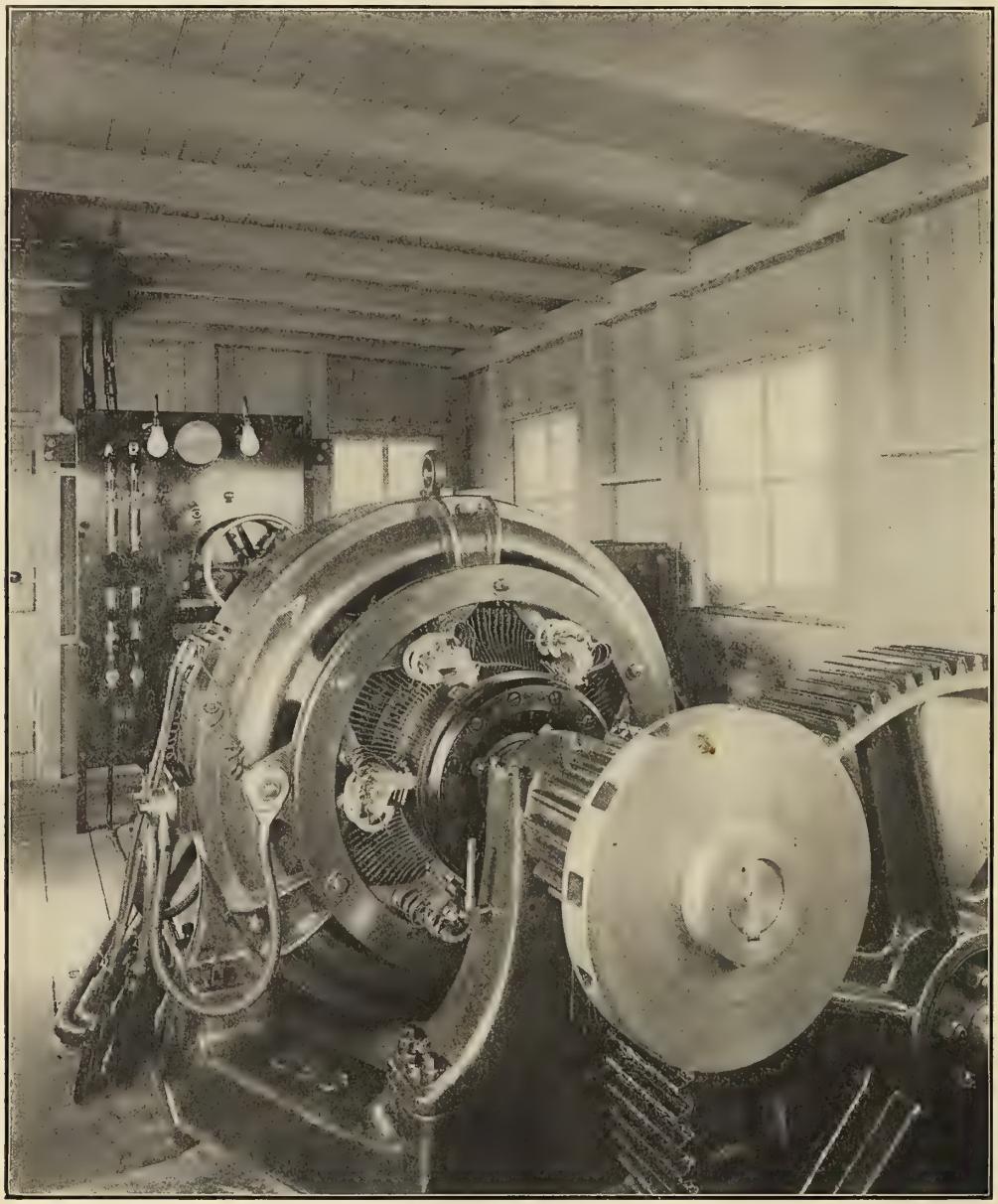
Marine Engineering.

SECTION OF WING OF DRY-DOCK, SHOWING PUMPS.

over 3-foot keel blocks. The dock is divided by a center longitudinal bulkhead, four side longitudinal and six cross bulkheads into fourteen water-tight compartments, each of which is provided with two pumps.

These pumps, which are all arranged along the deck of one wing, are of the standard dry-dock pattern, 14 inches square and 20 inches stroke, all operated by a 100-horse-power electric motor.

This motor was especially designed for the work under specifications of Faber du Faur and Donnelly, engineers, by the C. and C. Electric Company, and is a special application of the series-parallel system of control. The speed of the motor is 475 revolutions per



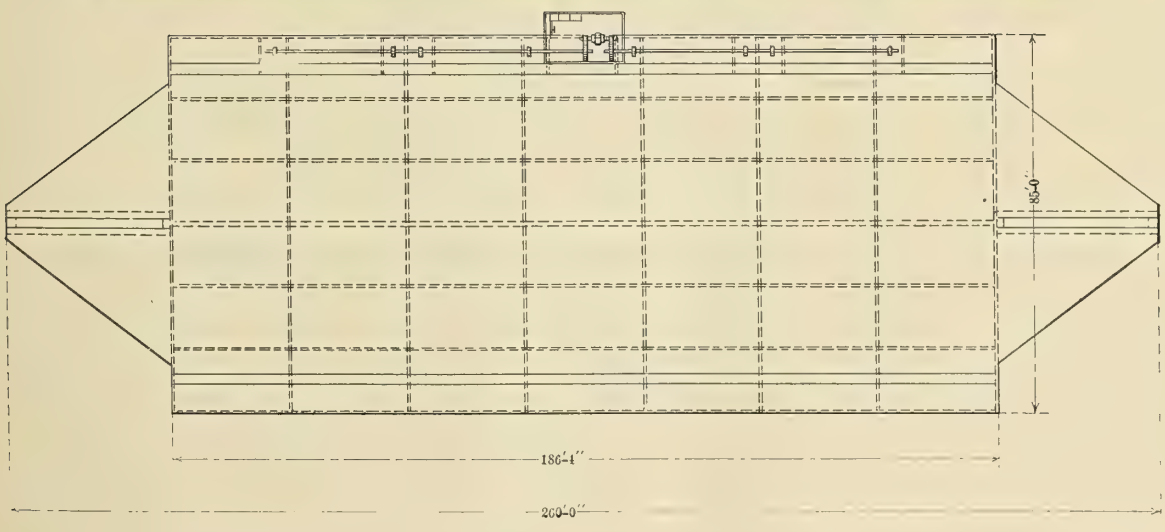
ELECTRIC MOTOR AND GEARING FOR OPERATING THE PUMPS OF A FLOATING DRY-DOCK.

minute; this is reduced by gearing to 110 revolutions of the line shaft and to 55 revolutions for the pumps, which speed will pump the full capacity of the dock, 3,000 tons, in about 35 minutes.

The motor is operated from the electric light company's mains at 240 volts; the current being led from the pier to the motor house on the dry-dock by flexible cables. The switchboard within the house is situated conveniently to the motor, as clearly shown in the photograph of interior of motor house. It is very essential in the docking of vessels to have a perfect and reliable control of the speed of the pumps, and the requirement of the contract was that the control should give at least ten different speeds, which should range from full speed down to 10 per cent. of full speed, and that the motor should operate continuously at any of the required speeds.

As the motor is necessarily exposed to salt air and moisture, thorough insulation was very carefully provided for, also the insulation of the pumping machinery (which of course is very thoroughly grounded to the water) from the frame of the motor. The installation has been an unqualified success and has now been in operation for several months without interruption of any kind. The pumping of dry-docks is a class of work for which electricity is especially adapted, as it requires a large amount of power for but a short time and at uncertain intervals and often at short notice; and where the source of electricity is available at any time of night or day, it is of especial value in case of an emergency which may require the docking of an injured vessel in the shortest possible time.

In addition to this dock the company has a dock operated by steam, 192 feet in length on keel blocks, with a capacity of 1,000 tons and a draft of 16 feet, and is also well equipped for repair work.



Marine Engineering.

FLOATING DRY-DOCK OF JAMES TREGARTHEN AND SONS COMPANY, ELECTRICALLY OPERATED.

PRACTICAL MOLD WORK IN SHIPYARDS.

BY SIDNEY H. MCLANE.

While shipbuilders are purchasing improved machinery to increase the output of their shops, and naval architects are designing details that will lessen the cost of production, too little attention is given in many yards to the method of actually building the ship. The construction plans of the ship, though they may have been the subject of much careful thought with a view of reducing the cost of construction as much as possible, may be turned over to a foreman who is incompetent to judge how to turn out work in the simplest and cheapest manner. Instead he may content himself with the old way of not starting one portion of the ship until all preceding parts are in place and then proceed to template off clips, liners, plates, etc., of which a large number could be made in duplicate and laid off for one-fourth the cost, besides the advantage of having the parts ready when wanted.

Some firms attempting mold work will allow a fitter to go ahead and make his own molds for that portion of the ship given him to construct, regardless of adjacent work, which might have been laid off from molds had the foreman decided in time upon the general method of laying out the remainder of the work. Thus adjoining parts may not be started until his work is all in place. In all yards enterprising enough to desire mold work as a means of reducing the cost of construction, there should be some one whose duty it would be to look after all the molds and loft work and to have direct supervision over the men using the molds. The material laid off should be tallied daily in a systematic manner. The man in charge should qualify as a thorough loftsman and fitter and be capable of estimating closely on work, in order that he may decide what work it would be profitable and more advantageous to lay off from the loft and what work should be templated.

Often, in shipyards where the template system is used extensively, the workmen, and even foremen, will try to place obstacles in the way of introducing molds because of increased production per man without extra compensation; for, with molds, fifteen plates would be a fair day's work, against three or four by templating at day wages. For this reason it is suggested that all men using molds come under the loftsman, as he could select men from whom there would be no opposition.

As to piecework, the only difference will be a reduction in the price of plates and shapes laid off molds, while the workman still earns the same wages with no increased manual labor.

One large item of expense which should not be overlooked is that of ribbands and the fairing of the ship by carpenters, the greater portion of which is unnecessary if the ship is laid off from molds, as the plating tends to fair the ship and holds the frames to the required spacing. The wages of ten or fifteen carpenters employed at putting on ribbands and fairing the vessel would amount to thousands of dollars during the construction of a large ship, which would pay for the labor and material used on the molds for the same ship many times.

In the largest yards on the Great Lakes, where mold work is used to the greatest extent, there are only three or four men and a boy in the loft during the busiest season of the year, but the work is done systematically and is thoroughly understood. A separate mold is not made for each plate, but a single mold is so arranged that all the plates of a large bulkhead or as many as one hundred deck or shell plates may be laid off from the one mold, as will be explained in detail further on.

Mold work enables the builder to proceed simultaneously with all parts of a hull. If he were asked what the use of his building slips would be worth to him for a period of three or four months each year, he would probably state a sum well up in the thousands; but does he realize that by methods of quicker construction the capacity of his slips would be increased to that extent?

The reduced cost of riveting must also be noted in connection with this work; for many parts of the ship can be assembled on the ground and riveted by machines at a much lower cost per rivet, and at the same time have the work so much nearer completion that when the parts are assembled there remains but a small quantity of riveting to do on the ship, with the exception of the shell and deck which must be riveted in place.

Some builders might object to the use of molds owing to the amount of lumber used, but at the same time they continue to pay bills for ribband lumber large enough to pay for the molds on several boats. With molds the fitters would be using but little template wood on the ship. Even to-day there are firms who make a wooden mold for each frame for use at the bending slab, and then carry the frames and floor plates to the screiveboard and to and from the punch in order to transfer the holes in the frames to the floors and beam brackets, while by simply laying off and boring the molds the expense of carrying hundreds of tons of steel to the screiveboard, and the cost of the expensive screiveboard itself, are done away with. Another disadvantage of the screiveboard is that only one frame in each body is under way at a time, and the frames have to be set so much nearer shape than when laid off from molds, as the floor plates will pull the frame to shape.

The cost of mold-making will vary greatly, according to the system used in joining the molds and transferring the lines from the floor to the molds. Apprentice shipfitters who are to be trained in the use of molds may be sent to the loft to make the molds with the aid of a carpenter to plane them perfectly fair, and the man in charge should mark all these for boring.

Some builders will allow a longitudinal with much twist in it to be laid off from the loft development; but when it comes to laying off a flat shell or deck plate from a mold, they either do not understand the principle of a practical method or do not care to try anything new.

The order of erecting a ship with framing and shell laid off from molds would be as follows: The keel plates would be laid on the blocks and lined up by keeping the center line on the plates over the center line on the blocks; the keel liners, butt straps, keel bars, center keelson plates, and stiffeners are placed in position and well bolted together. The riveting and calking should be commenced before any floors are placed. The garboard plates are then lapped on to the keel plates, to be followed by the succeeding strakes of bottom plating to the lower turn of the bilge. The outboard strake should rest upon a ribband substantial enough to carry the weight of the frames.

Framing may be commenced by erecting five or six

frames amidships, and the bottom plating, which has been resting on temporary shores with the exception of the outboard strake, should be bolted to the frames, the liners for the outside strakes having previously been laid in place, so that the bolting of the shell may be completed as the frames go up.

The side plating may now be commenced, starting at the top and working downward, taking care that the plates are exactly in place before being bolted up. It will not be found necessary to horn the frames, as the plating will bring the frames to the desired angle of the keel. The object in starting the plating at the deck is to keep the sheer fair. The usual method of fairing the frame with ribbands from the keel up causes the top of the frames to be unfair and necessitates templating off the beam brackets after a fair sheer line has been run on the frames, and consequently the work of placing the beams and plating the deck is retarded.

When it is inconvenient to erect frames with the beams attached, the beams should be put in place as soon as each frame is erected and secured. Starting with the deck stringers and gunwale bars, the deck plating should keep pace with the framing. The inside work, such as bulkheads, stringers, keelsons, inner-bottom plating (if any), etc., should follow the framing as closely as possible.

With mold work all lap holes in the frames and beams should be punched, as the customary drilling of these holes on a ship four hundred feet long amounts to over five hundred dollars.

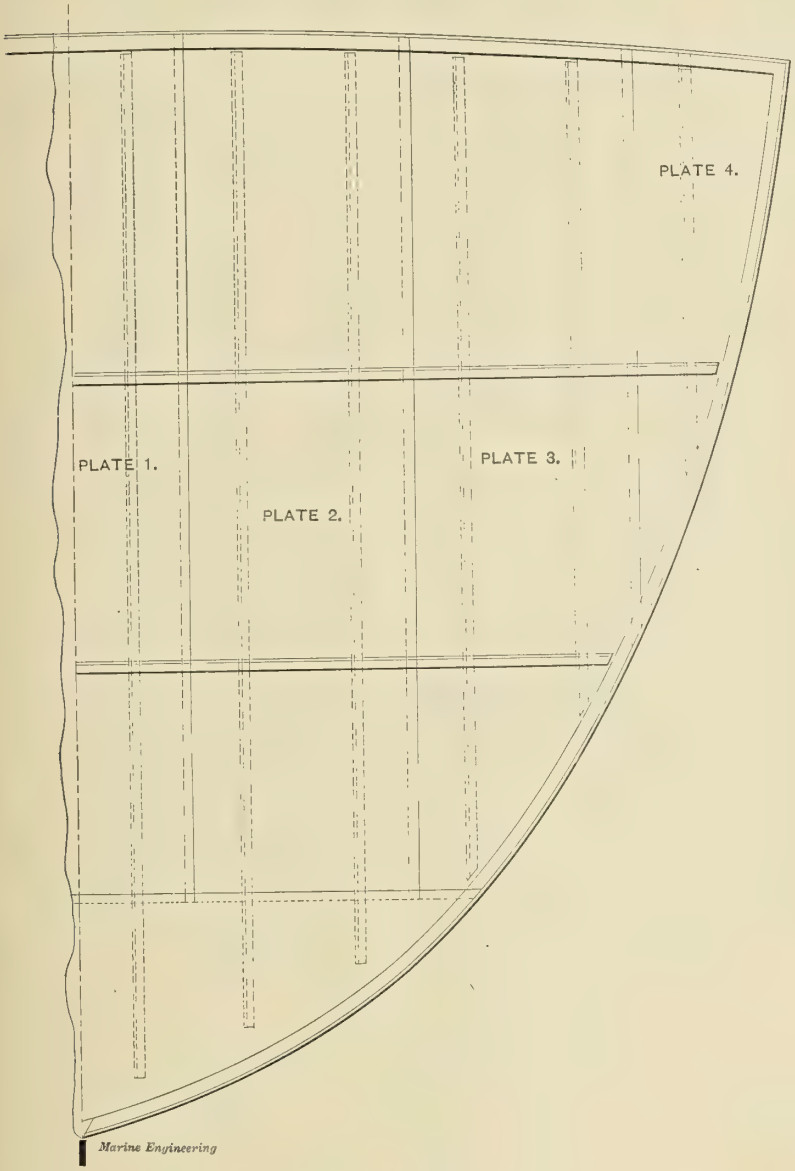


FIG. 1.

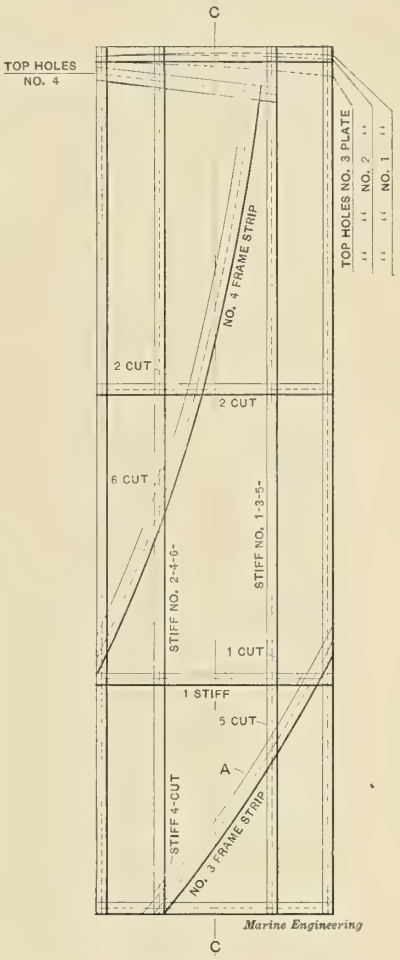


FIG. 2.

As an example of mold work we will take a small bulkhead of seven plates in width. Fig. 1 shows the general arrangement of the plating, plate No. 1 being a center plate with Nos. 2, 3, and 4 on each side. Each plate, with the exception of No. 4, is stiffened by two vertical and two transverse stiffeners.

The molds required would be as follows:

One frame and floor mold.

One plate mold.
One vertical stiffener mold.
One horizontal stiffener mold.
One beam mold.

The plate mold should be made of 1-4-inch template wood with all joints lapped to the dimensions of plate No. 1, with strips nailed on to receive the stiffener holes. It is then placed on the body plan in the loft and the crown of the beam marked on the top; it is then moved outboard to the position corresponding to that of plate No. 2, care being taken to keep the mold the same height from the base line. A line struck on the floor at the height of the transverse stiffeners will serve as a guide in moving the mold outboard.

The crown of the beam on No. 2 plate is now marked across the top of the mold and the latter then shifted to the position corresponding to that of No. 3 plate. In this position the strip *A*, Fig. 2, is nailed to the mold to receive the frame holes and also to show the lower boundary line of No. 3 plate; the mold is then shifted to the position of No. 4 plate and a similar strip is nailed to it to receive the frame holes and a strip at the top for the beam holes. The holes may now be spaced and bored. At the top, where the holes come quite close to one another, they should be plainly numbered. Holes to be used on any one plate only should be marked accordingly. After the mold is bored the battens to be used in laying off the stiffeners may be marked off, care being taken to show where all the stiffeners are to be cut and numbering each cutting mark. Both sides of the mold must be marked, so that the stiffeners may be laid off in pairs.

If the bulkhead to be laid off is a large one, the holes for the deck beams should not be bored, with the exception of the top hole in the lap to serve as a guide hole. A short beam mold the width of the plate should be made, and after marking off a plate, with the exception of the beam holes, the mold is removed from the plate and the short beam mold applied, the end holes of which should correspond with the top hole in the lap; the remaining holes and shearing line may now be marked.

For a steel mast simply a seam batten and butt mold are used. For the side plating of a ship the tip-up system is used, requiring a butt mold, seam mold, and frame batten with the sheer heights marked upon it. If a strake of plating is traversed by a line of holes for a fender bar, stringer, etc., a short mold will be used for the same.

[This method of procedure in building a hull is much different from the usual practice, and we would like to hear further remarks on the subject. No mention is made of using the mold for warped surfaces.—Ed.]

NEW ENGLISH CHANNEL STEAMER QUEEN, DRIVEN BY PARSONS TURBINES.

TURBINE CHANNEL STEAMER QUEEN.

There is now running successfully on the cross-channel service of the Southeastern and Chatham Railway a new fast steamer, named the *Queen*, which is specially interesting as it is propelled by three turbines. The *Queen* was built by Messrs. Denny, of Dunbarton, and is the largest of the present fleet of turbine-propelled ships. She has a length of 310 feet, a molded breadth of 40 feet, and depth of 25 feet. There are 3 decks running fore and aft, a promenade deck carried above and extending for about two-thirds the length of the vessel. The first-class passenger accommodations are in the forward part. On the lower deck are the sleeping accommodations for the men, and the dining room; on the main deck are the ladies' accommodations; and on the upper or awning deck are several large private cabins and a smoking room. A broad, sheltered prome-

nade space on this deck is especially appreciated by those who travel on this steamer.

The second cabin is placed aft of the machinery. The crew are accommodated on the lower deck at the stern, and the officers and engineers on the main deck amidships. Appliances for working the vessel are exceptionally powerful, and consist of a large windlass and capstan at the fore end and a warping capstan aft. The single-plate rudder is worked by Brown Brothers' steam tiller, controlled from the flying bridge by the maker's patent tiller motor. There is fitted at the bow a large rudder for convenience in backing out of the harbor; this rudder is also worked by steam-steering gear controlled by a wheel on the flying bridge.

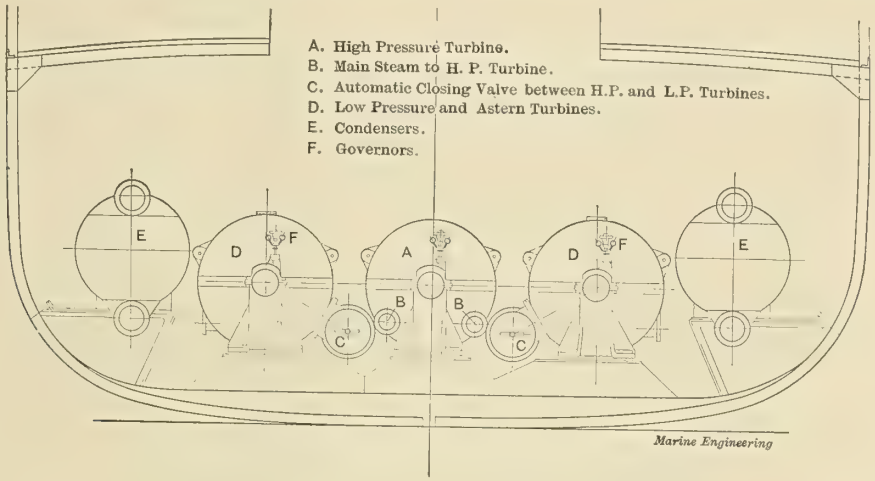
The boats are swung on special davits, which are fitted to work rapidly, and it is the intention to swing the boats out at all times, except when entering harbor or laying alongside.

The propelling machinery consists of 3 Parsons turbines—a high-pressure mounted on the central shaft, and two low-pressures mounted on wing shafts. On the central shaft, which revolves ordinarily at about 500 revolutions per minute, is placed one propeller, and on each of the outboard shafts, which ordinarily turn at 700 revolutions, is placed one propeller. It will be noted that this is a different arrangement from that first adopted with the Parsons turbine; in the former vessels two or more propellers were fitted on the outboard shafts, but experience has shown that the best results are obtained with but one propeller on each shaft. The accompanying diagram shows the cross section of the engine room of the *Queen*.

In ordinary going ahead the steam from the boilers is admitted through a regulating valve to the high-pressure turbine, and, after expanding about fivefold, it passes to each of the low-pressure turbines in parallel and is again expanded in them about twenty-five-fold, passing thence to the condenser; thus, instead of an expansion ratio of 12, as in the ordinary triple-expansion engine, it is 125 in this type of turbine. When coming alongside of the wharf, or when maneuvering, the outboard shafts only are used and steam is admitted directly to the low-pressure turbines. For going astern, special reversing turbines are fitted at the backs of the low-pressure casings, and the steam may be turned directly into them. Thus the port or starboard turbines may be worked ahead or astern and independently of each other and of the high-pressure turbine, which latter rotates idly in a vacuum under these conditions.

It is claimed that the *Queen* has exceptional manœuvering qualities; that on her trial on the Clyde, when steaming continuously astern, she attained a speed of 13 knots. Starting and stopping trials were also carried out, and the vessel when going over 19 knots was brought to a dead stop in 67 seconds after the telegraph order of reversing was given to the engine room, and the distance traveled in this time was equal to only about 2 1-2 times the vessel's length. On official trial the *Queen* attained a speed of 21.76 knots over the measured mile.

The air and circulating pumps for each low-pressure turbine are worked from one steam engine. The air pumps discharge into a float tank from which two Weir pumps supply two single-end Scotch boilers, fitted with forced draft on the closed-stokehold system. A marked difference is noticeable in this steamer from other fast vessels of the Channel fleets, in that there is practically no vibration whatever. Another innovation is that the funnels on the *Queen* are fitted with spark arresters of the Denny and Vrace type.



SECTION THROUGH ENGINE ROOM ON TURBINE STEAMER QUEEN.

At the launch of the turbine steamer *Queen Alexandria*, Mr. James Denny, in commenting upon the economy in coal consumption of turbine-propelled vessels, stated that if the *King Edward** had been fitted with balanced twin-screw triple-expansion engines of the most improved type, and of such size as would consume all the steam that the boiler could make, the best speed obtainable would be 19.7 against 20.5 knots actually obtained by the *King Edward*. The difference between these two speeds corresponds to a gain in the indicated horse power in favor of the turbine vessel of 20 per cent.

*The general description of the Parsons turbine and the *King Edward* were given in Marine Engineering for January, 1902.

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Notice to Advertisers.

Changes to be made in copy, or in orders for advertisements, must be in our hands not later than the 15th of the month, to insure the carrying out of such instructions in the issue of the month following.

THE retirement of Rear-Admiral Melville as Chief of the Bureau of Steam Engineering, United States Navy, marks the close of a career whose influence on naval engineering in the United States during the past sixteen years has been paramount, and whose relations with the development and progress of the entire art of marine construction the world over have been wide and fruitful. In another column the reader will find a brief synopsis of Admiral Melville's official career, and we have here but to add a word of appreciation, with such representative capacity as we may, from the field in which he has labored so long and so fruitfully.

Called in 1887 to the position which he has filled with such distinction since that date, the Navy Department was just entering upon wider plans for the upbuilding of the new Navy after the relatively timid start made in 1883. At the date of his appointment Admiral Melville was well down the list of chief engineers, and, having spent most of his life at sea, had found but small opportunity for showing his capacity for office and administrative work. Secretary Whitney, who made the appointment, doubtless realized, however, that at the rate and with the direction in which the Navy was then growing, there was needed for the position of chief of the Bureau of Steam Engineering a man possessing a wise combination of engineering ability, boldness, persistence of purpose, executive capacity, independence of thought, readiness to accept responsibility, and all tempered by good judgment and common sense. These the previous magnificent record in the Arctic on the De Long expedition, and elsewhere in the service, showed Admiral Melville to possess to an unusual degree.

That the appointment justified the expectation the history of the United States Navy during the past sixteen years abundantly proves. Added to his own high qualifications as an engineer, Admiral Melville has had likewise the rare capacity of surrounding himself with a corps of able, enthusiastic, and loyal lieutenants. The result has been a grade of naval engineering which, it is not too much to say, has set the world a standard. He has thus labored unceasingly and with all his energies for the upbuilding of the Navy and for the advancement of marine engineering both as a science and as an art. He has been bold and fearless in advancing and maintaining his opinions and measures, and tireless in carrying them forward into operation.

With these characteristics and with the success which has from the first met his efforts and crowned his policies, his influence has naturally run wide and deep through the period of growth with which he has been associated. His responsibilities have been great, but he has met and borne them with patient and patriotic devotion to his ideals of duty, and, in truth, any attempt to detail the points where his influence and policy have been moving factors would mean almost a history of the development of our Navy during the past sixteen years.

Admiral Melville is still in the midst of his vigor and capacity for work, and for such a man retirement from active duties at the Navy Department will only mean a transfer of activities to some other congenial field. He retires from his active service in the Navy with the assurance of leaving behind him an imperishable record of faithful and fruitful service, with the love and admiration of his assistants and associates, and we most heartily wish for him many years yet of health and activity in some part of the field of engineering work where he has already served so long and with such high distinction.

WE again have occasion to comment on another international yacht race for that much-prized trophy, the *America's* Cup.

Beginning with the *Genesta,* in 1885, the evolution of the cup challenger and defender from a sailing boat laid down by eye to the modern racing machine has been most radical and most rapid. Weight, which formerly was not a serious question, has now become a most important factor, second only to that of form. The construction of the modern boat has received the closest attention of specialists in many trades. Pre-eminently, of course, has come the form of the under-body, which under the racing-measurement rules for 90-footers has evolved from the cutter of the Englishman and the centerboard type on this side of the Atlantic to a long, narrow, shallow hull with immense overhang at bow and stern, and the lowest water lines dwindling into a fin with heavy lead keel at the bottom. Above deck, the mast, spars, and spread of canvas have increased enormously; the sail area of the *Puritan* was about 7,000 square feet, while *Reliance's* was over 18,000 square feet.

Given a certain length of water line, the naval architect's problem, once he has decided upon the form of hull, has been to design a boat to carry the maximum amount of sail. Displacement and sail area are the two important elements—to keep down the former and increase the latter; in other words, with a definite displacement, the greatest possible weight must be devoted to increased area of sail and making a stiff, heavy keel to hold the boat up under the sail.

On the other side of the water the combined talent of many experts has been directed to the study of these questions. Under the open purse of Lipton no expense has been spared in model experiments of many alternate designs to develop a boat that would lift the cup, while on this side Herreshoff has successively for many years been able to turn out a boat speedier than her predecessor. As was proved in the trial races this year between *Columbia, Constitution,* and *Reliance,* his claim, that if *Constitution* had been properly sailed two years ago she would have defeated *Columbia,* is verified. In his last design he profited by the experience of the Crowninshield-designed *Independence,* which was much larger in every way than either *Constitution* or *Columbia,* and proved herself to be a successful and practical type, although not a decidedly satisfactory boat. The great speed and superb sailing qualities of *Reliance* show the wisdom of the increase of 2,000 square feet of sail area over his previous designs.

The availability of the model of these great single-stickers for general yachting purposes is still a question, although at the close of the 1903 races this type seems to be in greater favor than it formerly was. The ability of Herreshoff to build the better boat, and, when once she is finished, for Captain Barr to get the most out of her, is a source of congratulation for us all. Regardless of the suitability of the type, the coming together of the yachts has been a great stimulus to the yachting profession and a means of strengthening the ties of friendship between ourselves and our cousins across the sea.

AMONG the many problems which confront both the practical and the designing engineer, few are of greater interest or perhaps of higher importance than those having relation to valve gears and steam distribution in general. With the view of helping the practical marine engineer in his study of such problems, we begin this month the publication of a series of articles by Professor W. F. Durand, and would call the attention of all who may be interested to the presentation of the matter to be given in this series. The valve gear is of importance both from an operative point of view and from the economic standpoint. Regularity and smoothness of operation, facility in stopping, starting, and handling, absence from pound and jar, all depend on the valve gear, as well as the proper point of cut-off and the general scheme of steam distribution best suited to economy of operation and maintenance. The problems connected with valve gear have long been a fruitful field both for the inventor and the practical engineer, and the number of valve gears, including minor varieties and secondary adjustments, is enormous. Of this vast collection of possibilities but few types have stood the test of practical experience, however, and the field becomes thus narrowed to the forms which have met the requirements of every-day experience under the exacting demands of advanced marine practice. With these types and their possibilities, however, the marine engineer should be fully conversant, and with a view of giving him aid in his study along these lines these articles have been prepared.

The fact that the articles are from the pen of Professor Durand will be ample guarantee as to their value.

THE DESIGN OF MARINE MACHINERY.

BY W. F. DURAND.

Valve Gears.

[1] Simple Slide Valve and Definitions.

It is the function of the slide valve and its operating gear to bring about the following operations:

(1) The admission of the steam alternately to each end of the cylinder and the closure of such admission at a point suited to give the desired degree of expansion.

(2) The release of the steam from the cylinders when the piston is near the end of the stroke, and the closure of such release near the close of the return stroke in order to give the needed compression.

These various conditions being properly fulfilled, there results within the cylinder a smooth and continuous motion of reciprocation, which outside the cylinder is transformed into a motion of continuous rotation by the agency of the connecting rod and crank. In addition, in all

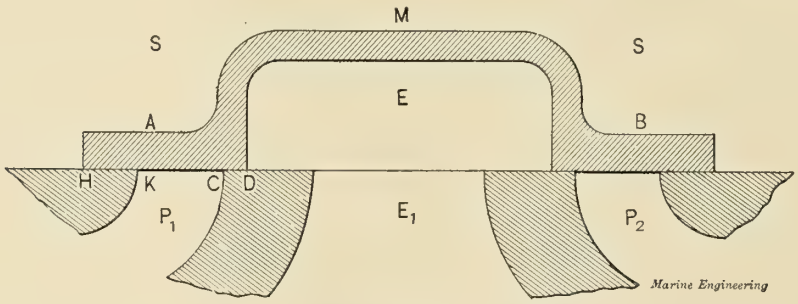


FIG. 1.—PLAIN SLIDE VALVE, MID-POSITION.

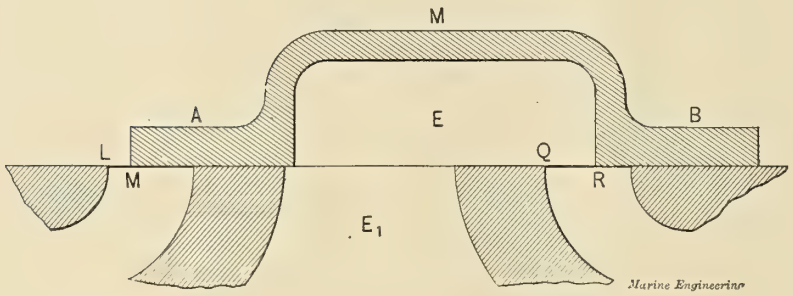


FIG. 2.—PLAIN SLIDE VALVE, POSITION FOR END OF STROKE.

reversing valve gears, the arrangement must be such that the motion of rotation may be produced at will in either direction.

Primarily, then, the valve gear must provide for four events in each end of the cylinder—steam opening and closure and exhaust opening and closure; and in all marine gears this must be under such control as to provide for operating the engine in either direction at will.

Before taking up the various forms of reversing valve gears, we shall, however, find it useful to examine the operation of a simple slide valve operated by a single eccentric.

In Fig. 1, AB represents a simple slide valve surrounded on the outside, SS, by steam, and in the position shown covering both P_1 and P_2, the passages leading to the two ends of the cylinder. The passage E_1 leads to the exhaust opening in the cylinder, and is separated from the live steam in the chest SS by the shell of the valve AMB. It may be readily seen from the diagram that if the valve AB is moved back and forth the port P_1 will be alternately placed in communication with the steam chest S and with the exhaust passage EE_1; similarly the port P_2 will be given the same connections as P_1 and alternately with it. That is, when P_1 is in communication with the steam, P_2 will for the most part be in communication with the exhaust, and *vice versa*. In a general way this is seen to fulfill the conditions above specified, and it therefore follows that if such a valve were given a reciprocating motion suitably timed

with regard to the piston, the necessary conditions might be fulfilled. Before considering the matter in further detail, however, we must first note certain definitions.

Let us suppose in Fig. 1 that the valve is in the middle of its travel to and fro. Then the distance *HK* by which the valve overlaps the port on the steam side is called the *steam lap.* The distance *CD* by which the valve overlaps the port on the exhaust side is called the *exhaust lap.* Again, in Fig. 2, suppose we have the valve in the position occupied at the end of the stroke. Then the distance *LM* by which the valve is open for the admission of steam is known as the *steam lead,* and the distance *QR* by which the valve is open for exhaust is known as the *exhaust lead.* In general, therefore, *lap* is the distance by which the port is covered when the *valve* is at its *mid*-stroke, while *lead* is the amount by which the port is open when the *piston* is at the *end* of its stroke.

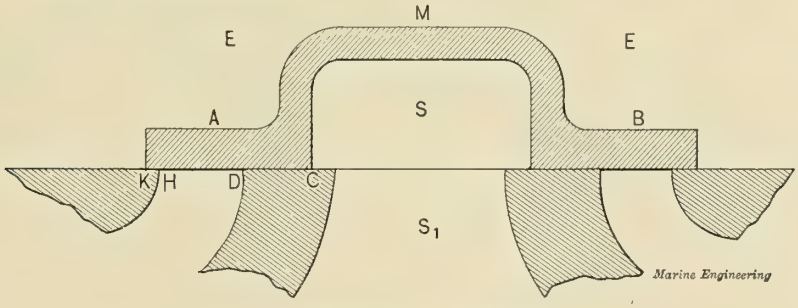


FIG. 3.—INSIDE VALVE, MID-POSITION.

[2] Outside and Inside Valves.

It is by no means necessary that the steam and exhaust sides of the valve should be related as shown in Fig. 1. It is frequently convenient to arrange the valve as in Fig. 3, in which the steam is connected with the inside and the exhaust with the outside. Such a valve

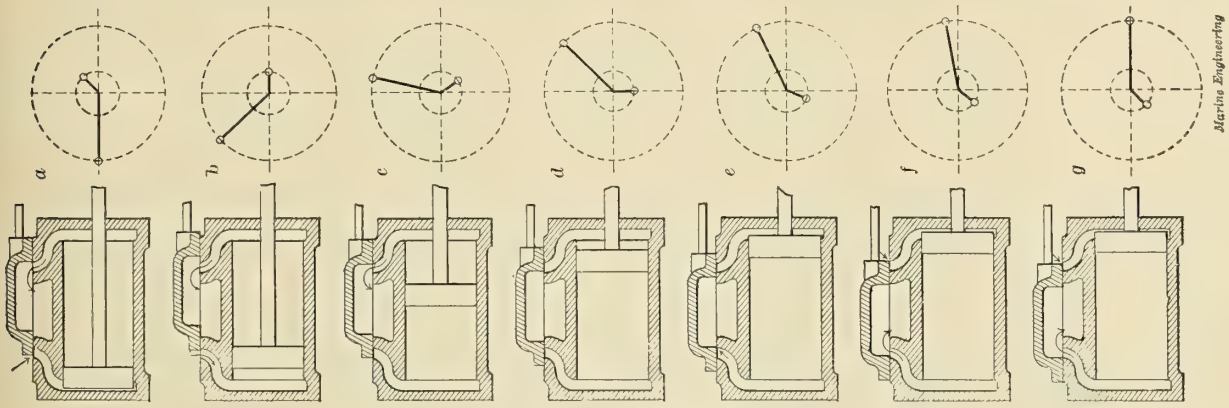


FIG. 4.—SERIES OF CRANK AND VALVE FOSITIONS.

is known as an *inside* valve, while the more common type of Fig. 1 is known as an *outside* valve. The steam here enters past the inside edge of the valve *C* and the exhaust escapes past the outside edge *K*. The inside lap, *CD*, becomes, therefore, the steam lap, and the outside lap, *HK*, becomes the exhaust lap.

[3] Movement of a Simple Slide Valve.

In Fig. 4 are shown a series of corresponding positions of the valve and piston during a single stroke of the latter. The position *(a)* is the same as that of Fig. 2, and the port is open for the admission of steam on the left and for exhaust on the right. The piston is at the end of the stroke and just about to begin the stroke to the right. In *(b)* the piston has advanced about 10 per cent. of the stroke, and the valve has moved so that the port is nearly wide open. Up to this point the piston and valve have been moving in the same direction. In *(c)* the piston has advanced to about 60 per cent. of the stroke, while the valve has come back and just closed the port to the entrance of steam. This is called the point of cut-off. Between *(b)* and *(c)* the piston has been moving on, but the valve has been moving back in the opposite direction. In *(d)* the piston has moved still further on, while the valve is still

moving to the left and has just reached the point where the exhaust opening on the right is closed. This is called the point of exhaust closure, and the operation of compressing the steam in the end of the cylinder from this point to the end of the stroke is called compression or cushion. In *(e)* the piston is still nearer the end of the stroke on the right, while the valve has moved further to the left and is just about to open the port on the left for exhaust, thus allowing the escape of the steam which entered during the early part of the stroke. In *(f)* the piston has nearly reached the end of the stroke. The exhaust opening on the left is open still wider, while the port on the right is just about to open for steam. In *(g)* the piston is at the end of the stroke, the valve has moved so as to make the steam and exhaust openings still wider, and the return stroke is about to begin. This completes the history of the stroke, and the next or return stroke follows after it with like series of events, and so on continuously.

Now, on the right in the same diagram is represented a series of positions of the crank and of an eccentric set somewhat more than 90 degrees ahead of the crank. A comparison between the positions of the piston and valve on the one hand and the crank and eccentric on the other will show that if the piston and crank were connected, and likewise the valve and eccentric, the two sets of parts would move together throughout the stroke with the relative positions as shown by the diagram. It follows, therefore, that an eccentric thus located would give to the slide valve the movements required for a proper distribution of the

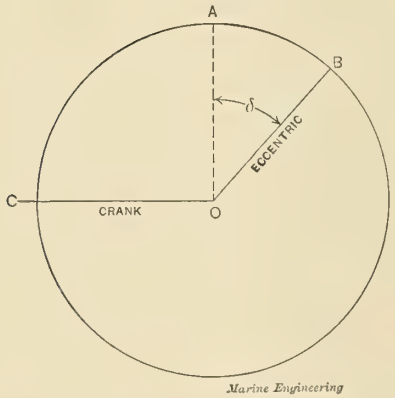


FIG. 5.—ANGULAR ADVANCE.

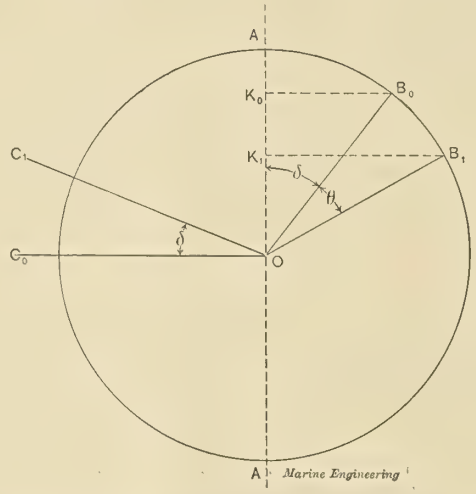


FIG. 6.—MOVEMENT OF VALVE DUE TO SIMPLE ECCENTRIC.

steam to the cylinder, as already noted. It will be seen later that among the various forms of mechanism which may be employed to give suitable motion to a valve, there is none so simple and direct as the eccentric, and, furthermore, that most of the problems connected with more complicated gears admit at least of approximate expression in terms of a simple eccentric gear. For this reason the simple eccentric gear furnishes a convenient starting point for the study of valve gears of more complicated forms, and we shall therefore consider first the elementary problems connected with this gear.

[4] Elementary Valve Gear Problems.

The quantities usually considered as entering into such problems are six in number, as follows:

Eccentric throw	denoted by r
Angular advance	" δ
Lap of valve	" L
Lead of valve	" l
Greatest port opening	" b
Point of cut-off.	

It will be noted that we take the eccentric throw as the radius of the circle described by the center of the eccentric, or as one-half the valve travel. Also, we shall take as the angular advance the angle *AOB*, Fig. 5, the excess of the angle *COB* over 90 degrees. There are, of course, various other quantities, such as the exhaust events, points of steam opening and re-

lease, which might be considered, but it is rare that such are made the subject of a fundamental requirement, and therefore they may be left for determination after the main problem has been solved.

The relations between these various items of the problem may be shown in a great variety of ways, both geometrical and analytical.

We shall first give the analytical relation, and this will serve as a convenient standard to which we may refer various geometrical constructions. In Fig. 6 let C_0 denote the crank when the piston is at the end of the stroke, and B_0 the corresponding position of the eccentric. Let C_1 and B_1 be the like positions after revolution through an angle θ. Now, in all valve-gear problems we find it, as a rule, convenient to reckon the movement of the valve from its own mid-position as origin. To a first approximation, also, the effect of all angularities of eccentric rods, etc., is neglected, so that the movement of the valve may be taken direct from a diagram, as in Fig. 6. When the crank is at C_1, therefore, with the eccentric at B_1, the distance

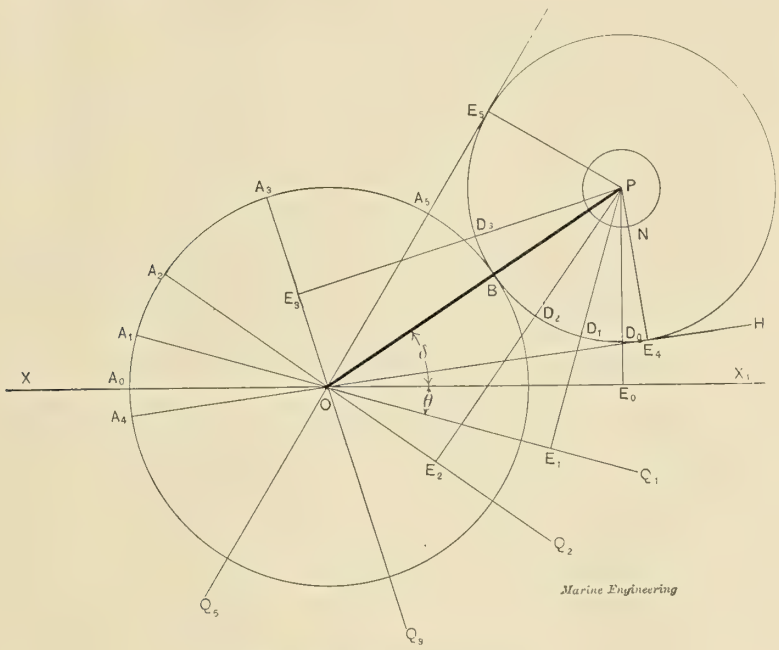


FIG. 7.—BILGRAM VALVE DIAGRAM.

which the valve will have moved from its mid-position will be shown by the line B_1K_1; and in general for any position of the eccentric the location of the valve measured from its own mid-position will be found by dropping a perpendicular from such eccentric position on the vertical AA.

Now, by trigonometry we have:

$$B_1K_1 = OB_1 \sin B_1OK_1 = OB_1 \sin (\theta + \delta).$$

In general we may denote K_1B_1, or the distance of the valve from its mid-position, by y, and we shall then have:

$$y = r \sin (\theta + \delta) \quad \ldots\ldots (1)$$

Expanding this we have:

$$y = r \cos \delta \sin \theta + r \sin \delta \cos \theta \quad \ldots\ldots (2)$$

Let us now denote the quantities $r \cos \delta$ and $r \sin \delta$ by P and Q, respectively. Then we have:

$$y = P \sin \theta + Q \cos \theta \quad \ldots\ldots (3)$$

Also,
$$P = OK_0 = r \cos \delta \quad \ldots\ldots (4)$$
$$Q = K_0B_0 = r \sin \delta \quad \ldots\ldots (5)$$
$$r = \sqrt{P^2 + Q^2}$$

then
$$\tan \delta = \frac{Q}{P} \quad \ldots\ldots (6)$$

In particular it will be noted that in equation (3) the movement of the valve is expressed as the sum of two terms, one of which is the sine of the crank angle θ and the other the cosine of the same angle, each multiplied by a coefficient which depends on the characteristics of the valve gear alone, the values and relations of these two coefficients being shown in (4) to (7).

[5] The Bilgram Diagram.

In Fig. 7, let the line OP be laid off in length equal to the throw of the eccentric, r, and at an angle with OX_1 equal to the angular advance, δ. Then, reckoning from A_0 as the crank

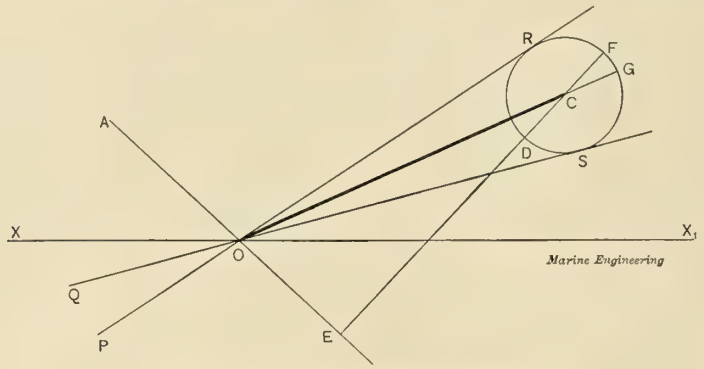


FIG. 8.—POSITIVE AND NEGATIVE EXHAUST LAP.

position for the beginning of the stroke, let any line A_1Q_1 be drawn through O, making the angle A_1OA_0 or Q_1OX_1 equal to the crank angle, θ. Then the angle $Q_1OP = (\theta + \delta)$, and by trigonometry we have:

$$PE_1 = OP \sin POE_1$$
$$\text{or } PE_1 = r \sin (\theta + \delta).$$

Comparing this with equation (1) in [4], it is seen that in the line PE_1 we have a representation of the movement of the valve from its mid-position for the position of the crank

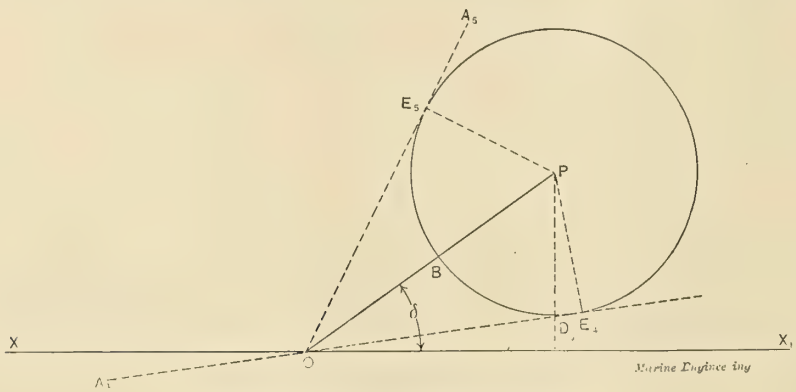


FIG. 9.—PROBLEM I WITH BILGRAM DIAGRAM.

represented by A_1, counting from A_0 as the starting point. Similarly for other positions of the crank denoted by A_2, A_3, etc., we have corresponding lines PE_2, PE_3, etc. Thus, in general, it follows that if through the point O any line AQ be drawn, making above XX on the left an angle equal to the crank angle, then a line PE drawn from P perpendicular to AQ will give by its length the movement of the valve from its mid-position.

If now we describe a circle about P with radius PD equal to the steam lap, then it follows, since the valve must move a distance equal to the lap before it begins to open, that the actual opening will be given by the distances D_1E_1, D_2E_2, etc., for the corresponding positions of the crank.

Also, since A_0 is the position of the crank for the beginning of the stroke, it follows that PE_0 is the corresponding movement of the valve, and hence D_0E_0 is the valve opening for this crank position, or, in other words, the lead of the valve.

It is also clear that lines A_4H and OA_5E_5, drawn so as to be tangent to the lap circle, will determine crank positions A_4 and A_5, for which the valve movement PE_4 and PE_5 is just equal

to the steam lap, and hence at these positions the edge of the valve will be at the edge of the port. This means that at A_4 the valve is just opening and at A_5 just closing, or, in other words, that A_4 determines the point of steam opening or admission, and A_5 that of steam closure or cut-off.

It thus appears that in this diagram the important features of operation of the valve are indicated as follows:

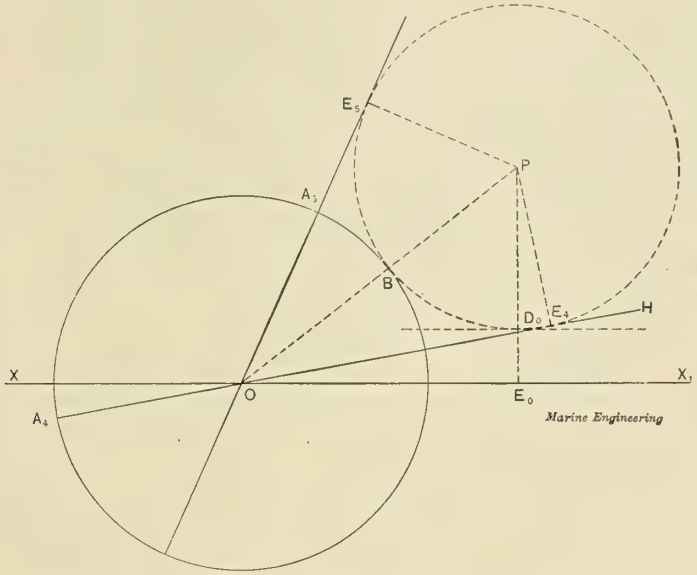


FIG. 10.—PROBLEM 2 WITH BILGRAM DIAGRAM.

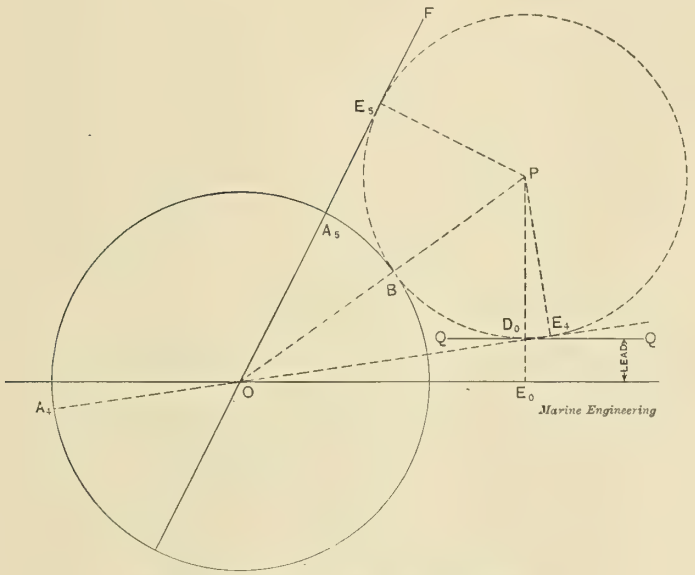


FIG. 11.—PROBLEM 3 WITH BILGRAM DIAGRAM.

Location of crank: OA_0, OA_1, OA_2, etc., reckoned from OA_0 as position at beginning of stroke.

Crank angle θ: Any angle A_0OA_1, A_0OA_2, etc.

Throw of eccentric: Distance OP.

Angular advance δ: Angle POX_1.

Movement of the valve from mid-position: Any line PE_0, PE_1, etc., determined by dropping a perpendicular from P on the line denoting corresponding crank position.

Steam lap: PD, radius of circle about P as center.

Port opening: Any distance D_0E_0, D_1E_1, D_2E_2, etc.

Greatest port opening: OB.

Steam lead: Distance D_0E_0, determined by drawing PE_0 perpendicular to XX_1.

Point of steam opening: Crank at A_4, determined by drawing line HOA_4 tangent to lap circle.

Point of steam closure: Crank at A_5, determined by drawing line OA_5E_5 tangent to lap circle.

In the discussion thus far we have assumed that PD, the radius of the lap circle, represents the steam lap, and the various items of operation thus refer to the steam or inlet side of the valve. The construction for the exhaust items is exactly similar, and we may on the same diagram draw an exhaust lap circle with radius equal to the exhaust lap, as shown by the small circle with PN as radius. The methods of construction and representation for the various exhaust items are then exactly the same as for the steam items already discussed.

It sometimes happens that the lap on the exhaust side of the valve is cut down so that when the valve is in mid-position the port is already open a certain amount to exhaust. This distance is known as *negative* exhaust lap. In the diagram for such a case the construction is exactly the same as for positive lap, except that we must consider the sides of the circle as inter-

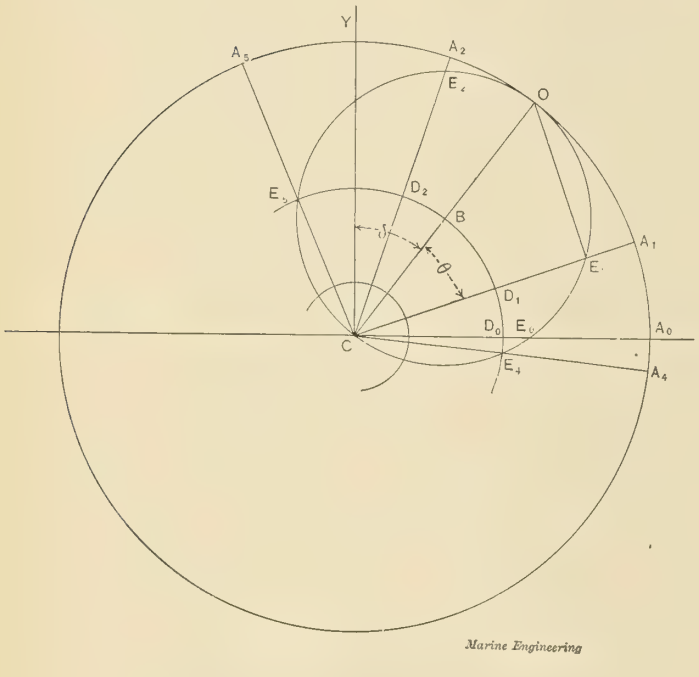


FIG. 12.—ZEUNER VALVE DIAGRAM.

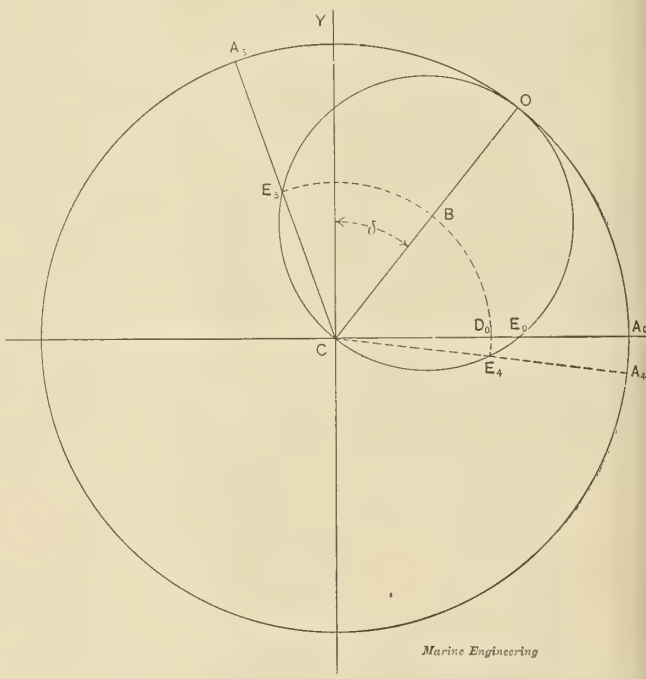


FIG. 13.—PROBLEM I WITH ZEUNER DIAGRAM.

changed and add the radius to the movement of the valve in order to find the port opening, instead of substract it. This is illustrated in Fig. 8. If the small circle about P as center represents positive lap, then the port opens to exhaust with crank in position OQ, while it closes with crank in position OR; that is, S is on the opening side of the circle and R on the closure side. If, however, the same circle represents negative lap, then R becomes the opening side and S the closure side, and exhaust opening will occur with crank in position OP and close with crank in position OS. Likewise the port opening for crank in any position OA will be DE for positive lap and FE for negative lap.

[6] Problems.

In all valve-gear problems as presented, a certain number of the preceding items are given and thus a part of the diagram becomes known. It is then required to find by geometrical construction the remainder of the diagram and the remaining items of the problem. Two or three of the more common problems will serve as examples of the method of procedure.

Problem 1: Given throw and angular advance of eccentric and the steam lap, required other items.

In the diagram of Fig. 9 this gives the items shown in the full lines. The remainder of the diagram is readily drawn in as shown by dotted lines, and the crank positions A_4, A_5, for

steam opening and closure, the amount of lead, D_0E_0, and greatest port opening, OB, are readily found.

Problem 2: Given points of steam opening and closure and the port opening OB, required other items. This gives the full lines of the diagram in Fig. 10, and it only remains to bisect the angle HOF and find by trial a circle tangent to the lines HO and OF and to the port opening circle about O as center. The remaining items are then determined as already explained.

Problem 3: Given point of steam closure, lead and port opening OB, required other items. This is the usual problem of valve-gear design. The lead fixes a line PQ, Fig. 11, and the other given items fix the full line part of the diagram. It is then only necessary to find by trial a circle tangent to PQ, to OF, and to the port opening circle. This completes the diagram and gives the various remaining items, as above explained.

Various other problems may be solved in a similar manner, and a very little study will serve to determine the necessary construction, once a sufficient amount of data is provided to make the problem definite.

[7] Zeuner Diagram.

In Fig. 12, let the line CO be laid off in length equal to the throw of eccentric and making the angle OCY equal to the angular advance. Then let A_0 denote the initial position of the crank and A_1 any other position making an angle θ with CA_0. Then, with the construction shown, we have by trigonometry:

$$CE_1 = CO \cos OCA_1 = CO \sin (YCO + A_1CA_0)$$
$$\text{or } CE_1 = r \sin (\theta + \delta).$$

It thus appears that CE_1, constructed as shown, gives the movement of the valve from mid-position for any location of the crank A_1. If, then, we describe about C a circle with radius CD_1 equal to the lap, the line D_1E_1, in a similar manner as in the Bilgram diagram, will represent the port opening.

A little study of the diagram will serve to show that the various items of the operation of the valve are here represented as follows:

Location of crank: CA_1, CA_2, etc., reckoned from CA_0 as position at beginning of stroke.

Crank angle θ: Any angle A_0CA_1, A_0CA_2, etc.

Throw of eccentric: Distance CO.

Angular advance δ: Angle YCO.

Movement of valve from mid-position: Any line CE_1 as a part of CA_1 representing the corresponding position of the crank.

Steam lap: Distance CD, radius of lap circle D_1D_2, etc.

Port opening: Any distance D_1E_1, D_2E_2, etc.

Greatest port opening: Length OB.

Steam lead: Length D_0E_0.

Point of steam opening: A_4, determined by drawing CA_4 from C through intersection of the two circles as shown, and with reference to A_0 as beginning of stroke.

Point of steam closure: A_5, determined by drawing CA_5 from C through intersection of two circles as shown, and with reference to A_0 as beginning of stroke.

On the exhaust side it is only necessary to draw the smaller exhaust lap circle, as shown, and proceed in exactly the same manner as for the steam side. The necessary changes in interpretation to provide for negative exhaust lap are also entirely similar to those in the case of the Bilgram diagram and will need no further explanation.

[8] Problems.

The solution of problems by the Zeuner diagram is carried out in the same general manner as already described for the Bilgram diagram.

The given quantities are represented as above specified, the remainder of the diagram completed in the simplest manner available and the desired quantities thus found.

For problem 3, however, as specified under the Bilgram diagram, the construction is very complicated, and this form of diagram can hardly be recommended for the solution of this particular problem. A single example will be sufficient to illustrate the use of the diagram.

Example 1: Given the throw of eccentric, point of cut-off and angular advance, required the remaining items.

The full-line part of the diagram is readily constructed as in Fig. 13, and the dotted part is then filled in, fixing the point of steam opening, the steam lap, steam lead, and port opening as shown.

(To be continued.)

QUERIES AND ANSWERS.

Q. 164.—Will you please advise me how to lay out a propeller blade so as to make a working drawing? F. C. S.

A.—The working drawing of a propeller blade must give the following information:

(1) The chief dimensions.
(2) The area and contour of the blade.
(3) The law of the pitch.
(4) The distribution of the thickness.

Assuming for simplicity that the pitch is uniform and the blade symmetrical and at right angles with the axis, the information needed in order to either make a pattern or sweep up the blade in loam may be laid out as shown in Fig. 1.

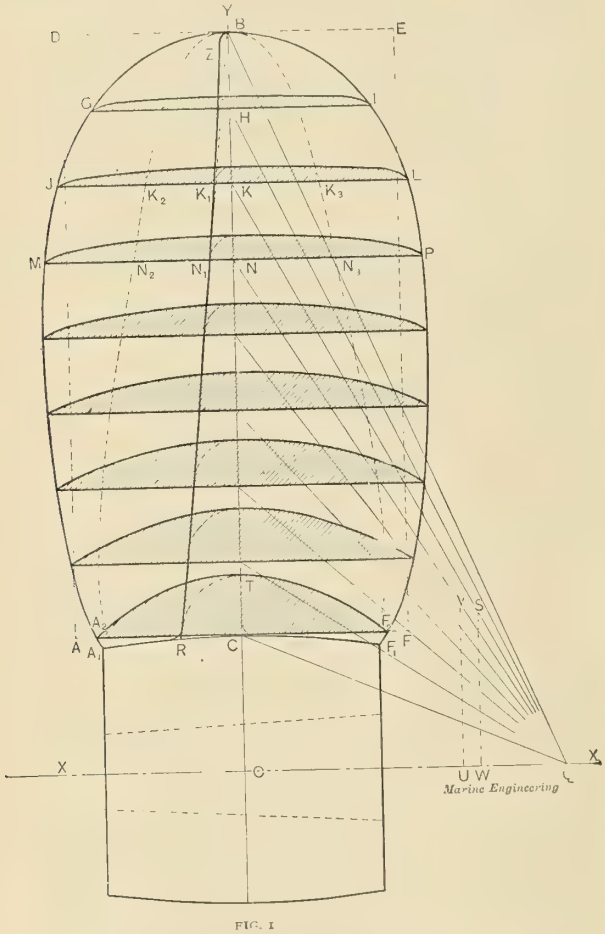


FIG. 1

Let *XX* be the axis of the shaft and *OY* a perpendicular. On *OY* take *OB* equal to the radius of the propeller. The hub may then be laid off as shown. The blade area in square feet is supposed to be known as part of the initial data. Knowing this and the actual length of blade *CB*, we may readily find the average width of blade. A rectangle, *ADEF*, may then be laid off as a general guide. Aided by this rectangle, we may then sketch in the actual contour of the developed area A_1MBPF_1, making it of such form as may be desired, and endeavoring by judgment to bring out the area the same as that of the rectangle. This area may then be checked by planimeter or by some of the modes of approximate computation, and the contour thus corrected until it satisfies requirements as regards both form and area. It may be here noted that for an oval blade the width at the root A_1F_1 may be taken from .8 to .9 of the maximum width.

We then divide the length of the blade *CB* into any convenient number of parts and draw lines across as shown. Then the widths *GI*, *JL*, *MP*, etc., are taken as the widths across the developed blade area at the corresponding distances from the axis. We next divide the value of the pitch by 6.2832 (the value of 2π), and lay off the quotient along the axis, as shown by *OQ*. That is, a length *OQ* is taken equal to pitch $\div 2\pi$. If then lines are drawn from *Q* to *B*, *H*, *K*, *N*, etc., the angles made between these lines and the radius *OB* will give at each point, *B*, *H*, *K*, etc., the slope of the surface relative to a transverse plane. That is, the angles *QBO*, *QHO*, *QKO*, etc., are the angles between the base and the hypothenuse of a series of guide irons, each of which, if cut to this angle, bent to the proper radius, and put in position, would lie with its face *BQ*, *HQ*, *KQ*, etc., in the helicoidal surface of the blade desired. These lines will therefore enable the pattern maker or molder to make such guides as may be desired in order to determine the surface required.

FIG. 2

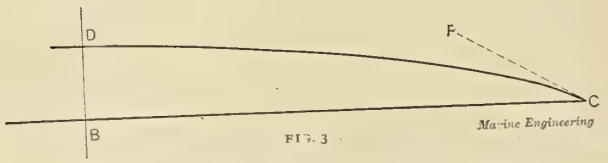


FIG. 3

We have next to specify the thickness of layout. To this end we lay off *CR*, the thickness at the root, and draw a straight line, *RB*. This would give a layout of middle thickness but for the fact that at the tip *B* it would be too sharp and fine for good casting. The thickness at the tip is therefore modified as shown in Fig. 2. A curve, *BS*, is laid in, giving the minimum thickness which can be cast with the material to be employed and which may seem suitable for the size of the propeller in hand. Such minimum thickness is usually from 1-4 to 1-2 inch. An easy reverse curve, *SD*, is then run from *S* to the line *BD*, and the line BZK_1R, Fig. 1, is then taken as giving the layout of middle thickness, while the area $CBZK_1R$ may be considered as a middle longitudinal blade section.

With radius *CR* an arc is then struck cutting *OB* in *T*. A circular arc is then struck through the points A_2, *T*, and F_2, and the section A_2TF_2 is taken as the blade section at the root. The actual junction of the blade with the hub is later modified by the usual generous fillet. In the same manner the other blade sections are run in until the outer sections, such as *JL* or *GI*, are reached. Here the edges would be too thin for good casting if the thickness were laid out as described, and a modification is necessary. In Fig. 3 let *BD* be the thickness at the middle. Then at *C*, the edge of the blade, lay off a line, *CF*, at the least angle for good casting. This will vary

from 6 or 8 degrees for the best bronze to 20 degrees or more for cast-iron. A smooth curve, *DC*, is then run in tangent at *C* to the line *CF*, and at *D* parallel to *BC*. This method will give a suitable blade section for the outer parts of the blade.

This completes the information needed to determine the blade and make either a pattern or mold in the foundry, as may be desired. Many special variations from this simple form of propeller may be met with, each requiring some modification in the details of the mode of laying down. Space forbids a detailed consideration of these points, but the principles involved are in all cases similar to those here discussed.

It will be noted that in this method of laying down a propeller blade the projected views of the blade are not referred to or used. Such views are, as a matter of fact, of little or no value in the practical operation of making a propeller pattern or sweeping up a mold in the foundry. The information actually needed by the pattern maker or molder is that given in Fig. 1, and with such information given in this form the pattern or the mold may be readily made without reference to the transverse and longitudinal projections.

In order to examine the question of clearance between blade and stern post or rudder, however, it may be desired to determine the projection on a longitudinal plane. To this end we may proceed as follows: On *QK* lay off *QS* equal to the half width *JK*, and drop the perpendicular *SW*. Then the distance *QW* is the projected half width, and this is laid off as KK_2, KK_3. Other points are found in a similar manner, and we may thus determine the projected view as shown by dotted lines.

Q. 166.—Will you please answer in your Queries and Answers column the following:

(c) Can time made as foreman or engineer in a stationary plant be counted on in application for a marine engineer's license?

(b) Will you please give a synopsis of the rules and requirements covering obtaining licenses?

(c) Where can I obtain a copy of the United States laws concerning marine-engineer licenses? B. D.

A.—The time served as a stationary engineer cannot be substituted for the required sea service in obtaining a marine engineer's license.

The answer to the second and third inquiries may be embraced in one. Copies of the Rules and Regulations and the application for licenses of engineers for the Lakes, seaboard, or western river service, issued by the Board of Supervising Inspectors of Steamboats, may be had by writing your local United States inspector or by writing to the Supervising Inspector-General, Steamboat Inspection Service, Department of Commerce and Labor, Washington, D. C. The kind of license depends on the size of the steamer the applicant has had experience on, and whether such steamer has run in the harbors, sounds, coast, or transatlantic service. Previous marine experience is always required. Besides this, a general knowledge of the character and operation of engine, boilers, and auxiliaries must be possessed by the candidate in order for him to successfully pass an examination. Full particulars may be had by writing to the local or supervising inspectors.

Q. 167.—In a catalogue of a well-known marine engine builder the following data for a 16 and 30-inch by 18-inch compound condensing engine are given:

Revolutions	210
I. H. P.	640
Initial steam pressure	150 pounds
Cut-off	1-3
Cranks	180 degrees

Will you please show me how these sizes of cylinders are determined for this power? I should say that the diameter was too small and the cut-off was rather smaller than good practice.

Is there any fixed practice in regard to the diameter of piston valves? W. D. R.

A.—To determine the sizes of the cylinders for a 640 I. H. P. compound engine under the conditions stated, the first step will be to estimate the probable mean effective pressure reduced to the low-pressure piston area. Cut-off at one-third stroke is earlier than is common in marine practice, and earlier than can be readily realized with the usual types of marine valve gears. At the most it is not likely that more than two expansions can be obtained so far as the high-pressure cylinder alone is concerned. The assumed ratio between the two piston areas is 3.51 to 1, and this with an expansion of 2 to 1 in the H. P. cylinder would give the expansion ratio of 7 in all. By the usual formula we find that for such an expansion ratio the mean forward pressure is about 69 pounds absolute, assuming no loss between the cylinders and no rounding off at the corners, etc. Taking 3 pounds back pressure, this would give an ideal mean effective of 66. With a good compound, somewhere about 70 to 75 per cent. of this may actually be realized. This would give a probable actual mean effective of about 47.5 pounds. We then take the horse-power formula,

$$\text{I. H. P.} = \frac{2\,pLAN}{33{,}000}$$

and put it in the form:

$$A = \frac{33{,}000 \times \text{I. H. P.}}{2\,pLN}$$

Substituting the values for this case, we have

$$A = \frac{33{,}000 \times 640}{2 \times 47.5 \times 1.5 \times 210} = 706$$

The nearest even diameter for this area is 30 inches, as specified for the engine referred to. Next, taking this area, we divide by 3.51, the ratio between the L. P. and H. P. piston areas, and find 201 for the H. P. area. The corresponding diameter is 16 inches, as noted. Had some other ratio between the piston areas been assumed at the start, or a somewhat smaller expansion in the H. P., as is more probable, the details of the design would work out differently and in accordance with the conditions assumed. With steam at 150 pounds gauge and a propeller which will allow 210 revolutions, there should be no trouble in realizing 640 I. H. P. with the engine as specified.

On the H. P. cylinder the diameter of the piston valve is very commonly made about one-half that of the cylinder itself. There is, however, no hard-and-fast rule. Where the valves are used, as is sometimes the case, on the intermediate cylinder of a triple or the low-pressure cylinder of a compound, each is made, if possible, of the same size as that on the H. P. cylinder. This is more easily done with the intermediate cylinder of a triple than with the low of a compound. In the latter case the diameter for the H. P. may be made about one-half the cylinder diameter, while for the L. P. two valves

may be used, each from one-third to three-eighths the diameter of the L. P. cylinder. These various ratios and sizes are intended to keep the values of the valve travel somewhere near the same, and thus to keep the throw of eccentric and other parts of the valve gear as nearly the same as possible.

Q. 169.—I have a 6 1-2-feet diameter by 10-foot Scotch marine boiler that seems to be a little slow in making the steam we think it should do on natural draft. It has a 7-foot 11-inch by 35-inch furnace; 151 2 1-2-inch by 7-foot 11-inch tubes; combustion chamber is about 23 inches between after tube sheet and water back. The smokestack is 28 1-2 inches diameter by 20 feet long. The boiler is allowed 150 pounds steam, but we only get 120 pounds, 130 pounds ordinary running.

Firwood is the fuel used, and we get better results without grates or bridge wall. All of the Scotch and Clyde boilers out here, in which wood is the fuel, use no grates, sufficient air coming in around the wood for good combustion. On our particular boiler I have experimented with a bridge wall raised to different heights in the furnace, but find the boiler steams better without than with one. As the wood burns out faster at the front end than at the back end of furnace, I have put in a 3-inch by 8-foot gas-pipe to carry air back to the rear end to help combustion there, but cannot see that this scheme has made any noticeable difference. The draft seems sluggish, although there is a fair rush of air going through the furnace when the dampers are open. With a brisk wind striking the vessel on the forward quarters the boiler will make steam and keep the safety valve lifting.

The feed water enters the boiler at the bottom, front end, through 1 1-2-inch feed. There are no inside distributing pipes to cause the feed to cover a larger area. Several good engineers have told me that a top feed issuing through small holes in a pipe lying close above the tubes would show much better results in maintaining steam pressure. It may be that the circulation in my boiler is poor. I have thought sometimes that it might be a gain to fit one of these patent circulators worked on the injector principle and thus relieve any possibility of poor circulation; but on a small boiler like mine I do not know whether there would be much net gain in better steaming qualities, after considering the amount of steam such a device would require to operate it. I have thought about adding 8 feet more of smoke-stack, and this change would probably be as practical, and certain to improve the steaming, as any, but it will surely destroy the symmetry and nice appearance of the steamer, and I have hesitated long on this account. What do you think about the proportions of my boiler for good steaming results, also the top-feed and the forced-circulation schemes? Engine is 10 and 20 inches by 16 inches, compound condensing, running at 136 to 140 R. P. M., cut-off probably 5-8 anyway; duplex boiler feed pumps 4 1-2 by 2 3-4 by 4 inches at 58-60 strokes per minute; independent circulation 4 1-2 by 6 inches at 280 R. P. M. I have thought some of cutting out this duplex boiler "robber" and substituting a line pump having a short stroke, say 4 1-2 inches, but do not know how large a plunger to order.

A. H. C.

A.—Your boiler seems to be in fair proportion, and the trouble with steaming is probably due to the special conditions under which it is operated. The funnel seems to be rather short for good draft, and you could most certainly improve matters by adding the 8-foot section to which you refer. Then, again, special care should be taken to make sure that the air has free access to the furnace from the outside. You do not describe how the boilers are enclosed, but there will be no use in adding to the funnel or in trying to improve the combustion without making sure that a full supply of air can gain easy access to the furnace. The admission of the feed at the bottom in the way you describe is also poor practice, and the change which has been recommended by other engineers would surely improve the circulation. You would do much better to change the feed pipe than to install any special circulating device.

The policy of substituting a connected pump for the duplex boiler feeder may be questioned. Less steam would certainly be required, but you would lose the convenience of independent operation, and, furthermore, the revolutions of the main engine are a little high for the best results with an attached pump. Should you decide to make this change, however, a single plunger, about 3 1-2 or 4 inches diameter and 4 1-2 inches stroke, would probably be found ample for the purpose.

Q. 170.—Will you please tell me how to plot the distance the link swings and also how to lay out the oval diagram which takes in the angularity of the connecting rod? I know about the Zeuner diagram.

F. W.

A.—The series of articles now being published in Marine Engineering and treating of valve gears and valve-gear problems will give information on the points referred to in your question.

LAUNCHES.

Schooner Yacht Vergemere.—On July 28 the auxiliary schooner yacht *Vergemere* was successfully launched from the yard of the Harlan and Hollingsworth Company, Wilmington, Del. Her principal dimensions are: length over all, 160 feet, on water line, 120 feet; beam, 28 feet; depth, 16 feet. She was designed by Messrs. Cary Smith and Barbey for Mr. A. C. Bostwick. All her deck fittings are of teak; the saloon is about 16 feet long and is finished in white with mahogany furniture and doors. The engine room takes up only about 9 feet by 16 feet, leaving ample room for state rooms on either side. The stack is telescopic in design.

Three-masted Schooner Yacht Atlantic.—At noon on July 29 there was launched at the Townsend and Downey shipyard, Shooter's Island, N. Y., the largest three-masted auxiliary schooner yacht ever built in America. She was christened the *Atlantic,* and measures 185 feet over all, and her beam is 29 feet. She is fitted with triple-expansion engines of 350 horse power, and has a sail area of 16,000 square feet. There are accommodations for the owner and 18 guests and it is intended to carry a crew of 35 officers and men. The *Atlantic* was designed by Messrs. Gardner and Cox.

Steamer San Jacinto.—A fine new steamer of the Mallory Line was launched on August 22 from the Delaware River Iron Shipbuilding and Engine Works, at Chester, Pa., and christened *San Jacinto.* With the exception of a ship of the Ocean Steamship Company, the *City of Savannah,* the new ship is the only steamer in the Atlantic coastwise trade fitted with twin screws. The ship is 404 feet in length over all, 53 feet 2 inches beam, and 34 feet 1 inch in depth, and the gross tonnage is given at about 5,500 tons, with storage capacity under decks of 330,000 cubic feet, equal to, say, 11,000 bales of cotton. She is designed for carrying 3,500 tons dead weight on a mean draft of 19 feet. The vessel is to be driven by two sets of triple-expansion engines with cylinders 27, 44, and 70 inches in diameter with a common stroke of 42 inches. Steam is supplied by three double-end and two single-end boilers working under natural draft and at 180 pounds pressure. The vessel was built under rules of the United States Standard Register of Shipping. Special facilities for rapidly handling cargo are provided. Accommodations for first- and third-class passengers are fitted on the upper and hurricane decks.

Cruiser Pennsylvania.—On August 25 the U. S. cruiser *Pennsylvania* was launched from the Kensington yard of the William Cramp and Sons Ship and Engine Building Company. The general dimensions of the *Pennsylvania* are as follows: length on load water line, 502 feet; beam, extreme, 70 feet; trial displacement, 13,800 tons; mean draft at trial displacement, about 24 feet 6 inches; load draft, 26 feet 6 inches. The ship will be propelled by twin screws driven by four-cylinder, triple-expansion engines of 23,000 horse power, the diameters of the cylinders being 38 1-2, 63 1-2, 74, and 74 inches by 48 inches stroke. Steam is supplied at 250 pounds pressure by 32 Niclausse boilers with a total grate surface of about 1,600 square feet and a total heating surface of about 70,000 square feet. The contract speed of the cruiser is 22 knots. The armament for this type of vessel is very heavy and consists of four 8-inch guns, mounted in pairs in balanced turrets on the center line, one forward and one aft. On the upper deck, at the corners of the superstructure, there are four 6-inch guns mounted in sponsons, one in each corner, while on the gun deck there are ten 6-inch guns, five arranged on each broadside. The secondary battery consists of eighteen 3-inch breech-loading rifles, twelve 3-pounders, two machine guns, and six automatic guns. There are two submarine torpedo tubes placed in a compartment forward for discharging 18-inch Whitehead torpedoes. The armor protection consists of a water-line belt, 7 feet 6 inches in width, extending for a distance of 244 feet amidships. The thickness is 6 inches at the top and 5 inches at the bottom. Protection is carried to the stem and stern by 3 1-2-inch side armor. From the top of the water-line belt to the main deck a 5-inch belt is worked in, and at the end of this armor 4-inch bulkheads are worked in athwartships. The ten 6-inch guns of the broadside battery are placed behind this armor. The turrets for the 8-inch guns are 6 inches in thickness and mounted in barbettes of the same thickness. The four 6-inch guns are mounted behind 5-inch armor. The conning tower is 9 inches in thickness. A complete oil-tempered and annealed nickel-steel protective deck, 1 1-2 inches thick on the flat and 4 inches thick on the sloping side, extends the entire length of the vessel, and behind this, from end to end, a cofferdam bulkhead filled with cellulose is built in. Large magazines are provided to carry abundant ammunition for all sizes of guns. The coal bunker capacity is 2,000 tons. Electricity is extensively used for operating the turrets and for many auxiliaries. The *Pennsylvania* is fitted as a flagship. The full complement of men numbers 822.

PERSONALS.

Nicholas C. Cushing, who was formerly with the New York Shipbuilding Company, has accepted a position in the brokerage department of Cary Smith and Barbey, naval architects, 90 Wall street, New York, N. Y.

Henrick Greger Pedersen, who formerly held a position as pump draftsman with the George F. Blake Manufacturing Company, is now with the B. F. Sturtevant Company as engine draftsman.

L. B. Bradford, having finished a special course in naval architecture at the University of Michigan, has accepted a position in the hull department of the Fore River Ship and Engine Company.

ENGINEERING SPECIALTIES.

Clocks for Shipboard Use.

The necessity of a good clock for use on board ship, whether in the pilot house, saloons, or engine room, is recognized by all; for the ordinary land clock is not well adapted to the hard service required of the marine clock, which must be damp- and dust-proof, and capable of accurate running regardless of the vibrations on board ship.

The clocks made by the Chelsea Clock Company, 16 State street, Boston, Mass., meet these requirements. They keep excellent time, and, with reasonable care, will last a lifetime. The parts are turned out in quantities by automatic machinery, and thus the cost of a first-class article is reduced to a minimum. They are made with cut steel polished pinions, hardened and polished pivots, compensation balances, seven jeweled escapements, and Breguet hair springs. These clocks, when used in dynamo rooms and on switchboards, if so ordered, are fitted with special non-magnetic parts which protect them from magnetism.

ACCURATE TIMEPIECE FOR SHIPBOARD USE.

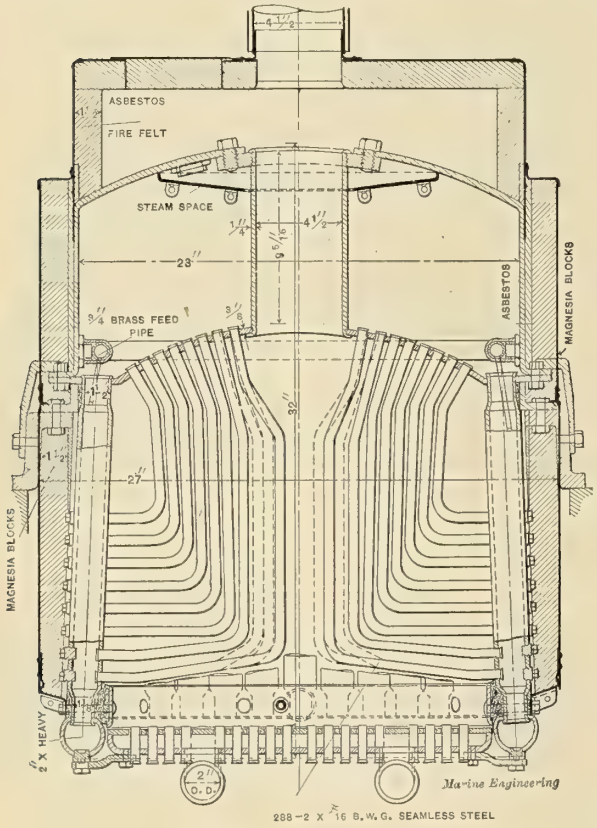
The clocks run eight days on one winding and are made in several standard sizes, among which are the marine (time only) clocks in sizes 4 1-2 to 12 inch, and also ship's bell clock, in 4 1-2 and 6-inch sizes, and mounted in screw-bezel cases which are especially suitable for yachts and steamships. These sizes of ship's bell clocks, and also larger sizes, when fitted with special bases and with hinged-bezel cases, are adapted for desk or mantel use. The annexed illustration shows a ship's bell clock on a special base, but the round clock may be bought without the base.

Many yachtsmen find that a ship's bell clock is very good for a sleeping room, as the correct time can be told every half-hour, which is not the case with an ordinary striking clock.

New Boiler for Steam Yachts.

In designing the *Neptune* boiler, fitted with a kerosene-oil burner, the aim has been to supply to the owners and builders of small yachts a safe, efficient, and economical steam boiler of light weight, occupying little space, a quick and rapid steamer, and accessible for cleaning and repairs.

This boiler has many novel features, both in design and construction. It consists of a series of manifold tubes arranged in a circle and placed close together to form the furnace and combustion chamber. The upper ends of the manifolds are expanded into the crown sheet, the lower ends into a mud ring. Within the



NEPTUNE WATER-TUBE BOILER.

furnace are placed the generating tubes, which are bent at right angles, with lower ends expanded into the manifolds and upper ends expanded into the crown sheet. The horizontal parts of the tubes are staggered, so as to close the spaces which otherwise would be made if the tubes were arranged in vertical rows. Covering the crown sheet and bolted thereto is the steam and water drum, a seamless drawn steel shell with dished head. A fire flue is placed in the center, connecting the dished head to the crown sheet, and through this the gases pass to the stack. Within the drum is the internal feed-water ring, placed above the manifold tubes. Openings drilled on the under side of this ring and directly over the manifold tubes, direct the feed water into the descending currents of circulation. At the highest point within the drum, and enclosing the fire tube to which it is fastened, is a baffle, or mechanical separator, from which steam is taken for the engine.

This arrangement of circulation or manifold tubes, and steaming or generating tubes, secures the rapid absorption of the heat by the water, and the continuous supply of water at a high temperature to the steaming or generating tubes.

In a well-designed boiler the best results are obtained by positive and continuous circulation of the water at all temperatures and under natural or forced draft. In this boiler the circulation of the water is positive because proper and definite passages are provided for the ascending and descending currents; those for the ascending currents being directly exposed to the highest temperature of the fire, while the passages for the descending currents are removed from the action of the highest temperature. The circulation is continuous, cannot be impeded or stopped, because the water in the descending passages can never acquire the same temperature as the water in the ascending passages.

Regarding the claim of safety, there are no screwed joints; all the tubes are seamless, their ends expanded and flared or beaded over; there are no welded or riveted seams; the effect of heat on any part of the heating surface cannot produce irregular strains, as all the parts are so constructed as to permit uniform contraction and expansion. The large water and steam drum provides for a considerable variation in the water level and a reservoir for steam, which is of the driest quality due to the fire tube passing through it.

The boiler is very light and occupies little space—one which will evaporate 450 pounds water per hour, from 60 degrees to 100 pounds steam, weighs but 560 pounds, including equipment, and is 27 inches diameter by 40 inches over all in height. The removal of the steam and water drum makes it easy for cleaning or repairs.

In connection with the boiler the designers have perfected a system of gasifying kerosene oil for fuel. This vapor or gas is formed by a special generator placed within the furnace, which, when once in operation, is continuous in action and delivers the gas to the burner, giving a perfect blue Bunsen flame of great heat. As there is complete combustion, there is neither smoke nor odor; and as the use of kerosene is perfectly safe, the equipment of a launch and small yacht with a Neptune boiler fitted with an oil burner makes an ideal steam plant.

The boiler was designed and patented by Messrs. C. F. Davenport and Harry Marks, and is for sale by Worth, Baily and Company, Witherspoon Building, Philadelphia, Pa.

An Improved Boiler Cleaner.

The importance of preventing or removing all scale formations from boilers, for reasons of both economy and safety, is so well established, and the difficulty of accomplishing it so well known, that every advance in this department of engineering is of pecuniary as well as humane interest to both the man who pays the coal bills and the engineer in charge of the power plant.

Innumerable devices and means have been invented to prevent the formation of scale in the boiler, and on the whole the conditions have been slowly improved. Notwithstanding scale still will form, and the means of re-

moving it are either by entering the boiler and chipping it off by hand or using some mechanical contrivance for doing the same work.

To any one familiar with the construction of boilers, especially of the fire-tube type, where the scale forms on the outside of the tubes, the impossibility of thoroughly cleaning the tubes of this scale by hand is apparent, and is the chief reason for the great favor into which mechanical cleaners have sprung with the trade. All these mechanical cleaners have taken the form of some device or machine which has entered the tube, and has a knocker or rapper that may be operated by hand or power, so as to rap or hammer on the inside of the tube sufficiently hard to jar the scale from the outside.

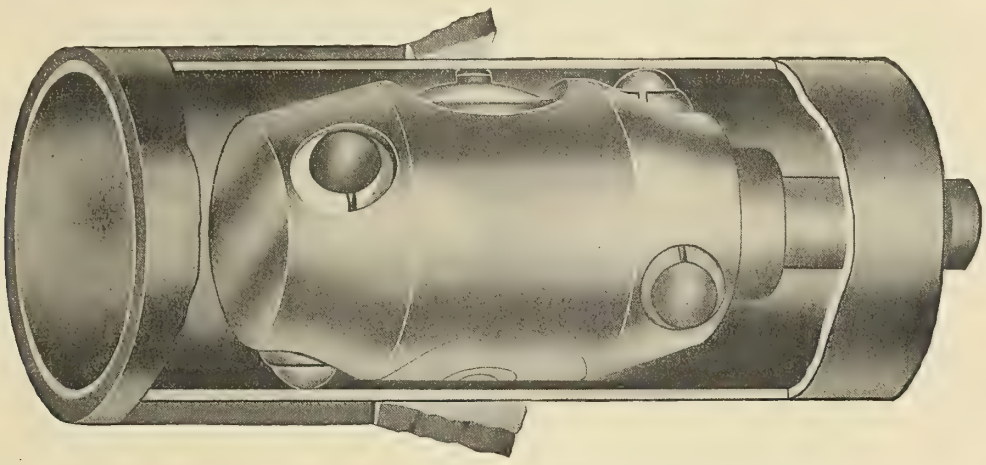
Up to the present time these machines, though simple to handle and effective in operation, have been designed with but one object in view, namely, to strike a sufficiently hard blow to do effective work. The result is that there is danger of injuring the tube, even puncturing it. The most effective and least dangerous method of rapping the tube is evidently in striking the highest possible number of light blows. The effect will be to set up a more or less local but very rapid vibration in the walls of the tube, which, by reason of the more brittle and non-elastic character of the scale formation, breaks up, loosens, and shakes off the latter without subjecting the tube to any undue strain.

The General Specialty Company has devised a steam tube cleaner of high piston speed. A double-acting knocker rod is firmly secured to the piston, and its travel is so limited that, though it is capable of exerting a sufficiently hard enough blow on the tube, it could not puncture it or injure it, because, even though the tube were not present to stop the motion of the rod, it would not travel beyond the point where the walls of the tube would be. This construction makes it possible to safely operate the machine at boiler pressure, thus obviating the necessity of using a separate steam gauge or reducing valve to lower the pressure. Two sets of centering lugs, one ahead and one back of the piston, which are forced out against the inner surface of the tube by steam pressure, accurately maintain the machine in the axis of the tube. Undue heating of the tube from the exhaust steam of the cleaner, with consequent possible loosening of the tube in the heads, is further avoided by expanding the steam before exhausting into the tube, so that its pressure is only a very little above the atmosphere.

An actual test of this machine showed a speed of three thousand strokes and upward per minute, according to the pressure used; nor was the temperature of the tube at the end of thirty minutes raised so much but what it could be easily handled without gloves.

The cut appearing herewith illustrates the cleaner in operation. Further information can be procured from the manufacturers, The General Specialty Company, 74 Carroll street, Buffalo, N. Y.

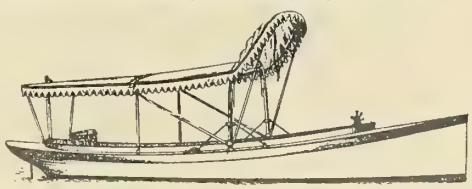
Paper Changes Hands.—The Engineer Publishing Company, Cleveland, Ohio, announces the purchase of *Steam Engineering* and its consolidation with the *Engineer* beginning with the issue of September 1, 1903, from which time subscribers to *Steam Engineering* will receive the *Engineer* twice a month.



BOILER-TUBE CLEANER.

SELECTED MARINE PATENTS.

734,516. LAUNCH COVER. JAMES C. COLLAMORE AND GRANT W. KERST, BROOKLYN, N. Y.



Claim.—1. A launch cover including deck plates, inverted U-shaped fore and aft frames pivotally mounted thereon, a shorter extensible center frame pivoted to said plates, and means for staying said frames. Fourteen claims.

734,519. SLEEPING BERTH. ELIJAH DAWE, COLLINGWOOD, CANADA.

Claim.—1. In sleeping berths, the combination with the side of the upper berth, of a bar pivoted at one end of the same and located to the inside of the berth, a stirrup pivotally connected to the opposite end of the bar and designed with the bar to hang downwardly from the side of the berth when in use. Seven claims.

735,595. DEVICE FOR LOCATING SHIPWRECKS. KUJI SATO, SAN FRANCISCO, CAL.

Claim.—1. A device of the kind described, comprising a buoy, a line of suitable length carried thereby attachable to an object exposed to be submerged, and a line check carried by the buoy and arranged to be engaged by the line when unwinding.

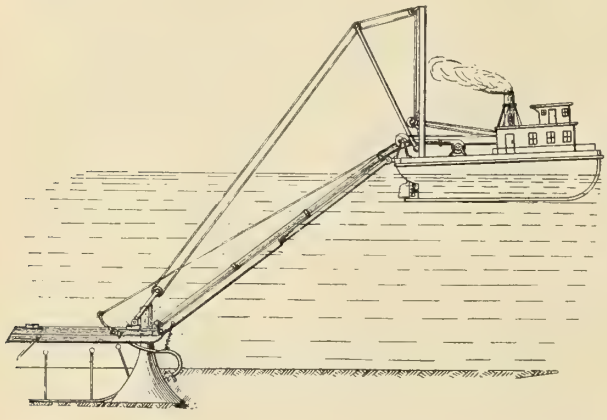
6. A device of the kind described, comprising a reel with a line of suitable length securable to an object exposed to be submerged, a buoy, a frame for supporting said reel and line from said buoy, and a line check carried by the buoy and arranged to be engaged by the line when unwinding.

7. A device of the kind described, comprising a buoy, a reel and line of suitable length attachable to an object exposed to be submerged and secured to said buoy, a protective covering for the line on the reel, and a line check carried by the buoy and arranged to be engaged by the line when unwinding.

8. A device of the kind described, comprising a buoy, a line of suitable length carried thereby attachable to an object exposed to be submerged, and a line check carried by the buoy and arranged to be engaged by the line when unwinding, said line check comprising an elongated spring clamp provided with a longitudinal slot the greatest width of which is less than the diameter of the line and through which said line passes and is retarded in its passage.

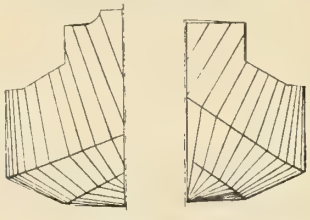
9. A device of the kind described, comprising a buoy, a reel carried thereby, a line wound on said reel attachable to an object exposed to be submerged, and a line check disposed centrally beneath said reel and arranged to be engaged by the line when unwinding. Nine claims.

734,615. SUBMARINE-CABLE-LAYING DEVICE. BEAUREGARD ROBERTS, MOBILE, ALA.



Claim.—1. The combination of a hollow submarine plow, beams adapted to support said plow, an adjustable framework for connecting said beams with a boat, a cable conduit carried by said framework and communicating with a delivery channel in the rear portion of said hollow plow, a fluid-conducting pipe carried by said framework and extending from said boat to a fluid-delivery channel in the forward portion of said plow, and means for raising and lowering said framework and plow. Three claims.

735,637. VESSEL HULL. HENRY N. WHITTELSEY, CAMDEN, N. J.



Claim.—1. An iron or steel vessel hull, embodying a series of transversely extending bottom-frame bars, a series of side-frame bars, the lower ends of which latter exist a considerable distance above the bottom-frame bars, a series of bilge-frame bars formed separately from and extending from the bottom-frame bars to the side-frame bars, the bottom-frame bars at the midship region of the vessel being approximately horizontal, the side-frame bars at such region being approximately vertical, and the bilge-frame bars being at such region at a suitable angle to extend from the bottom-frame bars to the side-frame bars, knuckles being formed at the junctions of the bilge-frame bars with the bottom-frame bars and side-frame bars, said frame bars having shell plate applied thereto.

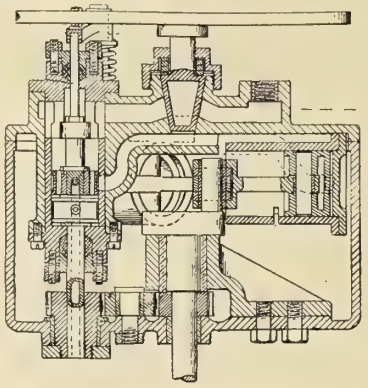
2. A steel or iron vessel hull embodying, in its construction, a series of straight or approximately straight, approximately vertical side-frame bars, a series of transversely-extending bottom-frame bars and a series of straight or approximately straight bilge bars formed separately from and arranged between said side-frame bars and said bottom-frame bars, and arranged at an angle to both, and shell plate applied to the exteriors of said bars. Eight claims.

735,985. ANCHOR-STOWING MECHANISM FOR SHIPS. JOSEPH KIDD, DULUTH, MINN.

Claim.—1. The combination with a hawse pipe constructed at its upper end to be secured to the deck of a ship, of an anchor pocket having a horizontally-disposed compartment for the reception of the flukes of an anchor and an inclined hollow extension secured to and communicating with the lower end of said hawse pipe, said pocket having an opening in its front for the passage of the flukes of an anchor into said horizontal compartment.

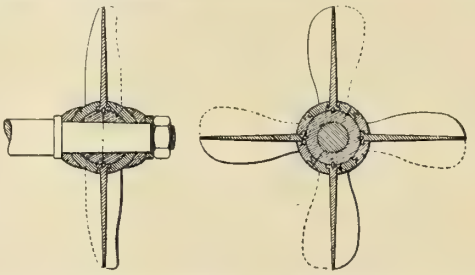
2. The combination with the deck and hull of a ship, each having an opening therein, of a hawse pipe secured to the deck under the hole therein, a pocket secured to the hull of the ship in line with the opening therein, and a hollow inclined extension on said pocket secured to and communicating with the lower end of said hawse pipe. Four claims.

735,675. MOTOR. JAMES L. PILLING AND ROBERT J. KRUSE, PORT HURON, MICH.



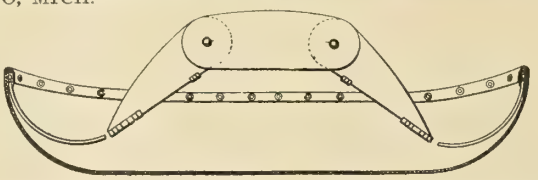
Claim.—1. The combination of a plurality of cylinders, a plurality of pistons and piston rods therefor pivoted to a single crank, a valve casing, a rotary valve provided with a hollow stem therein, means for actuating the valve from the main shaft, passages leading from the valve casing to the cylinders, a main exhaust from the cylinders, and a residual exhaust leading through the valve and through the hollow stem of the valve. Nine claims.

735,905. SCREW PROPELLER. GEORG PINKERT, HAMBURG, GERMANY.



Claim.—1. In screw propellers the combination of the conical shaft, screw blades, fixing flanges on said blades, a spherical boss secured on said shaft, a plurality of spherical segments with recesses adapted to receive the said blade flanges, clamping devices partly overlapping the said segments, and means for holding the various parts together. Six claims.

736,623. FOLDING BOAT. IRA O. PERRING, KALAMAZOO, MICH.



Claim.—1. In a folding boat the combination of a suitable flexible skin; a bottom consisting of central portions having extensions secured thereto by vertical pivots, the whole having cross grooves; hinges arranged toward the inner end of said extensions; hinges having tubular pivots arranged toward the outer end of said extensions; stem and stern ribs adapted to be inserted in said tubular hinge pivots; ribs of suitable spring material adapted to be engaged and retained by said grooves when forced into position, whereby said skin is stretched and collapsing of the boat prevented. Five claims.

736,692. BODY-INDICATING BUOY. HUGH CONDREN, VANCOUVER, CANADA.

Claim.—1. In a body-indicating device, the combination with a cap of an inflated buoyant chamber in the same, a body belt, and a light, strong line connecting them. Three claims.

736,363. MARINE-ENGINE GOVERNOR. IVAR CORNELIUSSEN, GALVESTON, TEX. Five claims.

Monthly Shipbuilding Returns.—The Bureau of Navigation reports that 106 vessels of 26,984 gross tons were built in the United States and officially numbered during the month of August, 1903. One-fifth of this tonnage was of wood sailing vessels, mostly built on the Atlantic and Gulf; another one-fifth of wood vessels propelled by steam; one-half of steel steam vessels, 9 in number; and the remainder embraces one large steel sailing vessel built on the Atlantic.